for . . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

PUBLISHER

THE INDUSTRIAL PRESS

President
ROBERT B. LUCHARS

Vice-President and Treasurer
EDGAR A. BECKER

Secretary
ERIK OBERG

EDITORIAL STAFF

Editor
CLIFFORD STROCK

Associate Editor
JOSEPH F. KERN, JR.

PUBLISHING INFORMATION

HEATING & VENTILATING is published monthly by the Industrial Press at 148 Lafayette Street, New York, N. Y. Western office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents.

ADVERTISING REPRESENTATIVES

Eastern Representative
ALGWYNNE COLLINS
148 Lafayette Street
New York, N. Y.

Western Representative
GEORGE G. TURNER
228 North La Salle Street
Chicago, Ill.

Copyright, 1941, by The Industrial Press

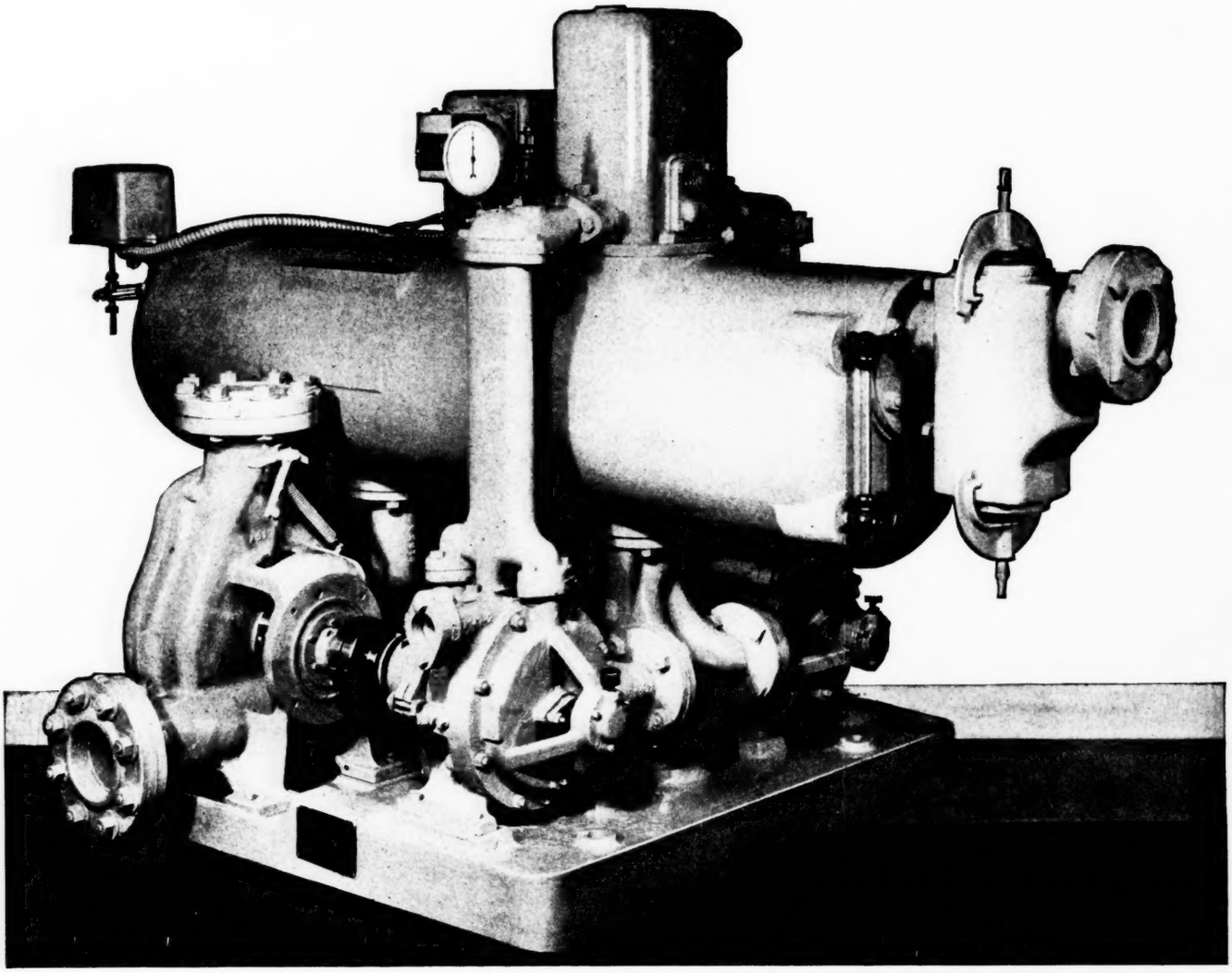
CONTENTS FOR NOVEMBER, 1941

VOLUME 38 NUMBER 11

Conditioned Air Tunnel System	25
Health vs. Comfort vs. Efficiency	28
Navy Takes Over Air Conditioned Junk	29
Profits in Air—Wright Aeronautical Corporation	30
Fans and Control for Tunnel Ventilation	38
Eggs Kept at 60F and 85% in Conditioned Vaults	42
Reference Data, 209 and 210	42
Saving Fuel by Lowering Inside Temperature	43
35-50% Voluntary Cut	46
Iceland's Hot Springs District Heating System	48
Stoker Markets Indicated in Survey	50
Testing Short Cut Method of Calculating Radiation	51
Washington News	55
Church Air Conditioned by Ice Storage System	57
Infection, Disinfection and Air Conditioning	59
Abstracts	60
News of the Month	61
New Equipment	74
Degree Days	76
With the Manufacturers	78
Personals and Personnel	78
New Trade Literature	80
Summer Degree Hours	81
Coming Events	81
H&V's Photos	81

MEMBER
Audit Bureau of Circulation
Associated Business Papers

Where building heat *MUST NOT FAIL* always specify the Nash Vapor Turbine



THIS SAFE NASH HEATING PUMP DOES NOT REQUIRE ELECTRIC CURRENT BECAUSE IT OPERATES ON THE SAME STEAM THAT HEATS THE SYSTEM

In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is entirely independent of electric current failure, and continues to operate as long as there is steam in the system.

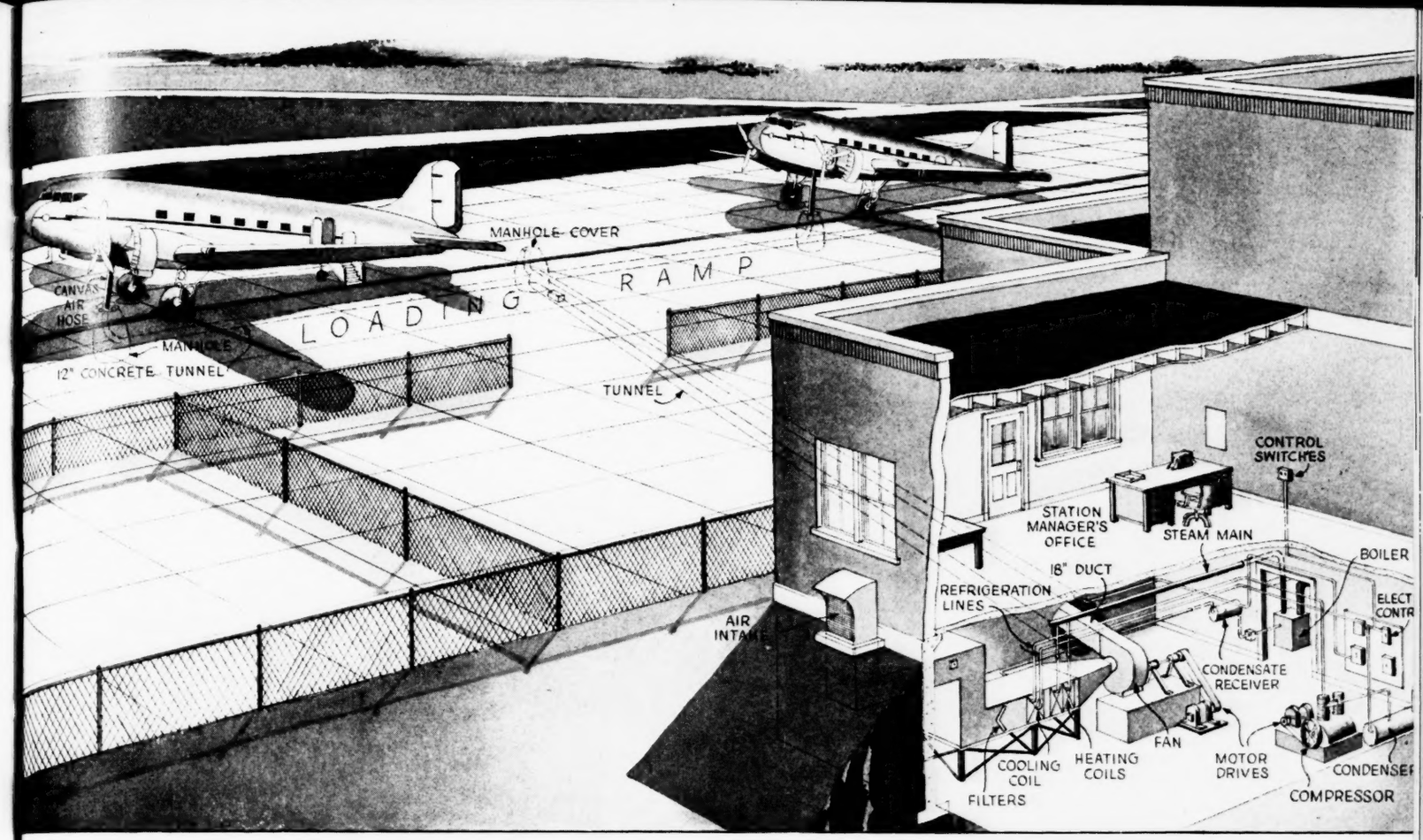
More than that, the Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump.

Greater savings still are effected by the Vapor Turbine in the system, for the reason that this pump operates continuously. It is the only pump that can do this with economy. Continuous operation means uniform circulation, and uniform circulation saves steam.

The Nash Vapor Turbine has but one moving part, rotating in the casing without metallic contact, and requiring no internal lubrication. Quiet, compact, and trouble-proof. Bulletin A-290 is free on request.

THE NASH ENGINEERING COMPANY

239 A S. WILSON ROAD • SOUTH NORWALK, CONNECTICUT • U. S. A.



Conditioned Air Tunnel System

at Northwest Airlines terminal supplies air to planes from central plant. System and control described by Milton Figen.

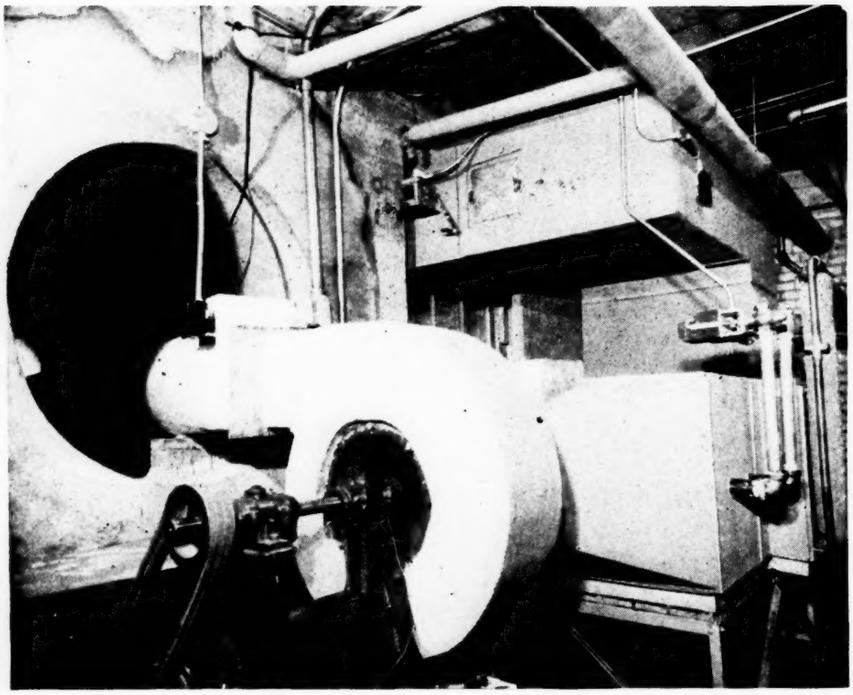
THE heating and cooling of passenger planes while in flight is no new development for the comfort of air travellers. Planes today fly at high enough altitudes to allow for the introduction of the cool upper air, when required, for natural cooling of cabins; and the heating of cabins is a problem which in most cases has been solved simply by utilizing power from the planes' motors.

But the maintenance of proper temperatures in modern passenger air liners during the intervals between arrivals and departures from terminals — in summer and in winter—has been a problem which has occupied the attention of airlines for some time.

The loading and refueling of ships between flights takes considerable time during which motors are shut off. When the motors are off heat is no longer supplied to interior of a ship. For this reason, and because it is impossible to employ more than a moderate amount of insulation in the construction of cabins because of weight limitations, the planes get cold rapidly during stop intervals. Passengers waiting for the take-off are chilled and time is consumed too, after the planes have taken off, to build cabin temperatures back to the comfort level. In the summer the opposite extreme is true. Aground under the hot sun the metal bodies of the planes heat up quickly and the passengers suffer. There is also the time lag after take-offs before natural cooling can restore comfortable temperatures.

Most widely utilized in the United States as a means of controlling temperatures under these circumstances is the portable air conditioning unit, which, mounted on a truck, is driven to the ramp where a landed plane has pulled up. There, through a flexible air hose attached to the belly of the ship, it supplies conditioned air to the plane's cabin. But busy airports where great numbers of ships arrive and depart daily have a special problem in that many planes may require attention simultaneously thus necessitating several portable units.

Setting a precedent among American air transport passenger services, the Northwest Airlines, in its Minneapolis, Minn., terminal, is the first to develop and place in actual operation a tunnel system for supplying conditioned air the year-round from a stationary central plant conditioner so that a number of planes may be serviced at one time. The installation is of unusual interest in the long distances the conditioned air must travel through the ducts in the underground tunnels



Conditioner in background, with fresh air inlet overhead. Fan outlet feeds to 18 in. duct in the tunnel.

from the conditioner to the delivery points. In all there are 558 feet of tunneling carrying the same number of feet of ductwork, while the average distance from the conditioner to each of the outlets is 308 feet. The installation is also of interest in the high pressure, six to eight inches of water static pressure, used in the blower which forces the air through the tunnels.

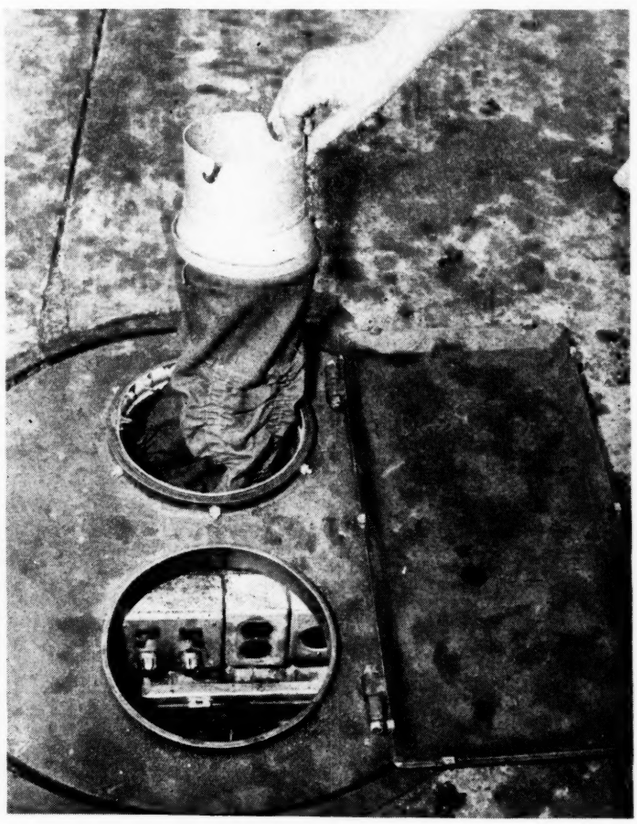
The air conditioner is located in the basement of the Administration Building which is approximately 100 feet from the edge of concrete ramp where the planes unload. Fresh air is drawn into the conditioner from an intake, equipped with motor-operated dampers, on the side of the building. The air is drawn first through a set of six throw-away type spun glass filters and thence through a six-row direct expansion McQuay cooling coil, equipped with a thermal expansion valve and a heat exchanger, with a face area of 21 x 41 in. Next in line are an Aerofin single row tempering steam coil and a double row steam heating coil. Each has a face area of 6.2 sq ft.

The air is pulled through a Buffalo Forge exhauster type fan which delivers 2,500 to 3,000 cfm of conditioned air at the static pressure mentioned. The fan motor is a 7½ hp, 220 volt, 60 cycle, three-phase unit driven by a V-belt drive.

For the summer cooling, cycle power is provided by a unit consisting of a four-cylinder compressor, a 15 hp, 220 volt, 60 cycle, three-phase motor and a 15-ton capacity shell and tube condenser.

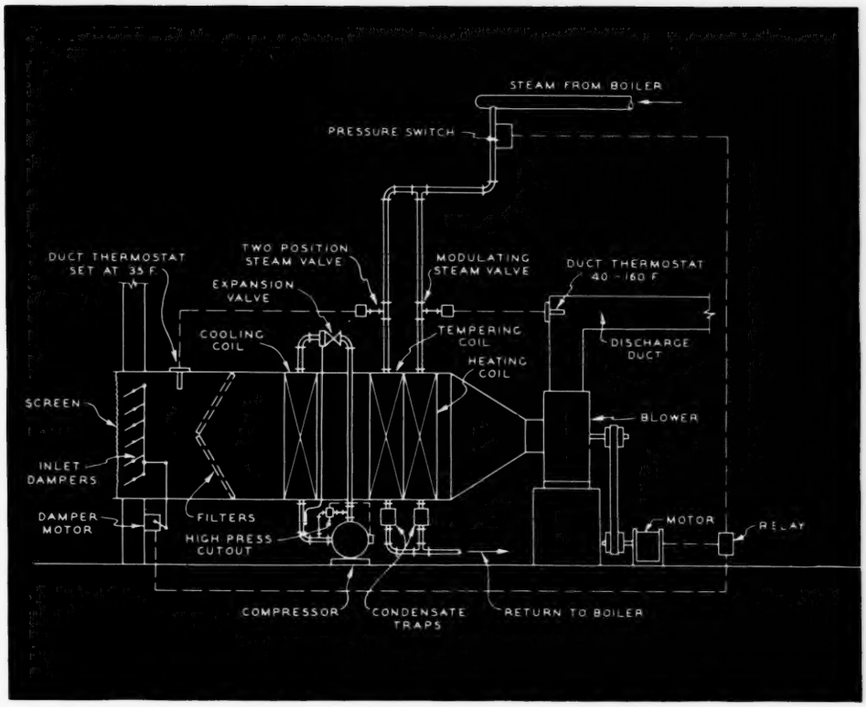
During winter operation heating power is obtained from a Vapor Car Heating Co. flash boiler operating at 75 to 100 lb gauge pressure and with a capacity of 360,000 Btu per hour. This boiler uses fuel oil and is complete with boiler feed pump, blower and necessary equipment to make it fully automatic in operation. The boiler has condensate return traps and a vented receiver to collect the condensate and supply the boiler feed pump by gravity. A float control valve on this tank regulates make-up water as required.

From the air conditioner an 18 in. round trunk duct, 108 ft long, extends through a 4-ft tunnel to a central point beneath the concrete loading ramp. From the central point beneath the ramp the duct divides into two 12 in. branches which carry the air, at right angles from the trunk duct, a distance of 225 ft in either direction beneath the loading ramp. Along these branches, at 150-ft intervals, are vertical shafts where the ducts are extended up to the ramp surface. Manholes cover the outlets.



Manhole, showing the flexible duct and fitting for connection to the plane.

Control diagram for the air conditioning system at the Northwest Airlines Minneapolis Terminal.



Upon arriving at the airport passenger plane pilots maneuver the big ships into position on the ramps so that the wheels stop directly on the large circles painted on the concrete. This places the ships in the proper positions over the service manholes. The covers of the manholes are then lifted and retractable canvas air-sleeves are pulled up and connected by means of attaching nozzles to the bellies of the ships. The final step in supplying conditioned air to the ships' interiors is the snapping of the remote control switches beneath each manhole cover. The station manager has general control over air conditioning service through the master switch which is located in his office in the Administration Building.

The flexible connection from the manhole to the plane is here being hooked up.

The control system for the air conditioner is relatively simple. The intake damper is powered by a two-position damper motor as previously described. The damper is normally closed, opening only when the fan motor is started through operation of a relay connected with the fan.

Controls for the cooling equipment include a high pressure cut-out for the Freon compressor and a solenoid-operated valve on the water line to the condenser.

The cooling cycle was designed for operation under a maximum inlet air temperature of 100F dry bulb and 75F wet bulb, with the refrigerant lowering the temperature of the air at the fan discharge to 55F to allow for a 10F rise (to 65F) at hose outlets.

Controls on the heating cycle consist of a two-position steam valve for the tempering coil, a modulating steam valve on the main heating coil, a duct-stat located just inside the intake and set at 35F for controlling the steam valve supplying the tempering coils, a modulating duct-stat (40-160F) inside the discharge for controlling the modulating steam valve on the main steam coil, and a reverse acting pressure switch in the steam main to close down the fan in the event of low steam pressure. The heating cycle was designed for operation at a maximum inlet temperature of —20F, delivering 140F air at the fan discharge and 125F air at the hose outlets. The heat output is 350,000 Btu per hour.

The air conditioning system was designed in the engineering laboratories of the Northwest Airlines in St. Paul, Minn., with the Conrad Manufacturing Co., Minneapolis, representing the General Refrigeration Co., Beloit, Wis., handling the installation.

The author acknowledges the assistance of V. C. Lundquist, project engineer of Northwest Airlines, in furnishing the data for this article.

Health vs. Comfort vs. Efficiency

By F. W. HUTCHINSON†

Application of the principles of air conditioning to the control of the atmosphere in which men live and work offers the engineer an unusual opportunity to utilize scientific knowledge directly for the benefit of mankind. Coupled with this opportunity there is however, a decided responsibility for the correct use of such knowledge. It will be the purpose of a series of articles, of which this is the first, to investigate those factors which must be given full consideration by the engineer before he will be able to say, with assurance, that the air conditioning system which he has designed will be of unquestioned value as an aid to comfort or to health or to efficiency. If you read Professor Hutchinson's opening remarks you will want to read the complete article.

IF, in a time of national crisis, air conditioning engineers were instructed to disregard the health and comfort of industrial workers, but to establish a working environment in which output would be, at least temporarily, a maximum, they might set about the assignment by:

1. Raising the temperature and humidity in the working space so that the effective temperature would be higher than the value corresponding to comfort; tests have shown that output increases as the effective temperature is raised above the value at which optimum comfort is realized. Other tests suggest that efficiency is a function of dry bulb rather than effective temperature, but, whichever is correct, the conclusion is unavoidable that maximum temporary output is greatest in an uncomfortably warm environment.

2. Sealing the working space and increasing the pressure within it to 60 pounds per square in. gauge (four atmospheres, absolute pressure). Again, tests show that effectiveness as measured by output of the workmen would be increased. However, reference to the extensive literature on the health hazards associated with the deep sea diving will demonstrate strikingly that work under high pressures is by no means conducive to health.

3. Equipping the working space with mildly irritating noise-making devices. When such noise is present, experiments have shown that output is increased in spite of (or possibly because of) the neurotic effects leading in some cases to mental breakdown.

These possibilities obviously represent a set of conditions so extreme that they are beyond the realm of practical interest to the air conditioning engineer. It is unlikely that industrial air conditioning be designed to overwarm, compress, or irritate the worker. But the examples do demonstrate from three different points of view that control of environmental conditions for maximum working effectiveness is not synonymous with control either for health or for comfort. On the contrary, the first item of change, temperature, suggests that in some instances the effect of summer cooling installations may be to improve comfort at the expense of effectiveness (as measured by short time output).

The conclusion must be that air conditioning for efficiency is not necessarily synonymous either with air conditioning for comfort or for health.

Comfort vs. Health

Having disposed of efficiency it remains to be demonstrated that health and comfort are themselves not synonyms. If the conditions which lead to increased comfort were found to be destructive to health then it is unlikely if the gain would be accepted by many persons as justifying the loss. That such a condition is not impossible can be demonstrated by many simple analogies. If, for example, one were to take a hot bath and afterward dress in the manner which would be most conducive to comfort, there would be little doubt that this form of dress would differ from that which would be most conducive to health. A situation comparable to that of the hot bath results when indoor summer temperatures are held down to values which give optimum comfort; present knowledge suggests that indoor summer temperatures somewhat higher than those corresponding to ideal comfort are likely to be more healthful. In this respect the experiences associated with early cooling installations, head colds, etc., suggest that the control point for such systems was at a level so *comfortable* that unhealthful shock effects resulted from entrance into or exit from the cooled space.

If the engineer is to persist in using the sensation of comfort as a measure of the healthfulness of a particular environment he must first disprove the time-worn adage that "what people want is not always best for them."

The misconceptions inherent in certain commonly used air conditioning terms apparently are of even earlier origin than the misuse of the word health in referring to comfort. Drinker has called attention to the fact that so-called *comfort charts* are in reality charts plotting conditions not of comfort, but of equal warmth. They show that for certain combinations of temperature, humidity and air motion the occupant experiences an equal sensation of warmth, but it does not follow from this that equal comfort, a psychological term including variables other than warmth, is realized in different environments for which the sensation of warmth is the same.

There seems to be good reason for believing that neither the sensation of warmth nor the feeling of comfort are the factors upon which air conditioning should be designed, and it is not improbable that the future will bring a chart of atmospheric variables grouped in such a manner that lines can be drawn through conditions representing environments equally conducive to health.

†Assistant Professor, Dept. of Mechanical Engineering, University of California.

Function of Air Conditioning

Air conditioning might be defined as the control to conditions conducive to health of all atmospheric factors. Among such factors are temperature, humidity, radiant energy, air motion, distribution, ionization, dust, odors, bacteria, and contaminating gases or vapors. A mere catalog of the factors involved is sufficient to show that the problem is a considerable one. The most reasonable method of attack and the one which has been most widely followed is to break down the general problem into particular cases and to investigate each separately. Unfortunately the value of data obtained in this manner is somewhat restricted because in physiology the convenient engineering *principle of superposition* does not hold true; in consequence, a knowledge of the effects of high humidity with normal temperature and high temperature with normal humidity does not lead to a quantitative knowledge of the effects of high humidity associated with high temperature.

As a further complication the effect of acclimatization comes into play: the transient physiological effects attendant upon removal from one atmosphere to another may exceed in importance to health the difference in environmental conditions that exist between the atmospheres.

Briefly, it may under certain conditions be more conducive to health to remain permanently in an atmosphere which is not ideal from the health standpoint than to be required to enter for periods of short duration such an atmosphere from one which is ideally suited to the maintenance of health. The chief purpose of health conditioning, according to Dr. R. C. Gary of the University of Glasgow, is "the production of such an external environment that the body may, in its turn, maintain the physiological integrity of its internal environment and that with the minimum of strain." It will be noted that when acclimatization is considered this definition must be qualified with the statement that minimum of strain refers to the 24-hour day and not merely to the period spent in the conditioned space.

Boundary Conditions

The engineer designing a comfort air conditioning installation is restricted in his selection of conditions of operation to an extent far greater than would be true in most other branches of mechanical engineering In establishing a comfortable environment the judgment of the engineer is limited to the selection of variables which will lead to a desired result subject to two non-engineering boundary conditions. On the one hand microclimatology, through weather, dictates the selection of outside conditions and requires an unusual degree of flexibility and prompt response from the conditioning equipment. At the other boundary physiology dictates both the temperature level and the method of establishing an energy balance at the body surface. The task of the air conditioning engineer is then to work in a range of varying width bounded on one side by weather and on the other by physiology. The engineer working alone can do no more than arrange atmospheric variables in such a way that comfort can be obtained by adequate but not excessive heat transfer; he can arrange for the disposal of body heat once it has been brought to the body surface, but must rely on the doctor for statements concerning the physiological phenomena involved in getting body heat to the surface and for an understanding of the effects, internally, of the various mechanisms by which he arranges for the transfer of heat externally.

Practical Importance of Physiological Data

While the investigation and statement of the effects of atmospheric variables on persons and the range of permissible variation in such factors as temperature, humidity and air motion remain essentially in the sphere of the medical man, it is nonetheless important for the practicing engineer to have a sufficient background so that he will be able to:

1. Estimate the probable effect on health of the occupants of such engineering methods as may be available for use by him; and
2. Estimate the extent to which extreme atmospheric conditions may constitute a health hazard and thus be able to deduce when and to what extent air conditioning may be essential to avoidance of an industrial health hazard.

With respect to the latter the interest of the practical engineer is very real, since such knowledge is a prerequisite to the sale as well as the design of conditioning equipment for use in the hot industries, for marine service, in the solution of dust control problems, and for the removal of hazards due to toxic vapors.

To assist in establishing a practical background of information useful to the busy engineer on the health effects of atmospheric variables, the author has prepared a series of articles summarizing the effects of extreme environmental conditions and of extreme variations of the various atmospheric variables. The first of the series, to follow, will deal with temperature, the effects on man of high and low temperatures and limits in departures from the average temperature range beyond which there may be a health hazard.

Navy Takes Over Air Conditioned Junk

The Navy got a bonus when it took over Mrs. Anne Archbold's Chinese junk for $1 recently.

When the crew took over, it found quarters far more luxurious than the most modern battleship. Furnishings, for instance, include a Carrier room air conditioner designed for use specially in high tropical temperatures. Mrs. Archbold had the junk air conditioned in 1939 for a cruise in South Sea waters.

The Navy rechristened the junk the *U.S.S. Cheng Ho* and is using it as a station ship at Pearl Harbor.

The *Cheng Ho* is of 154 tons, 99½ feet long. It was named for Admiral Cheng Ho, who sailed to Persia in the fifteenth century with 150 junks. Above the water line the craft is a copy of fifteenth century junks. Below are twin screws driven by 110 hp diesel engines.

Built in Hong Kong in 1939, the vessel first sailed to Manila and thence to the Dutch East Indies for the Fairchild Garden Expedition.

WRIGHT AERONAUTICAL

Lockland (Cincinnati) plant is world's largest U. S. aircraft engine plant. Thirty-three-acre is year-round air conditioned; project has

ABOUT a year ago the Wright Aeronautical Corporation was asked to increase its output of aircraft engines to meet the needs of the Defense Program. Following conferences it was decided that a new plant would be built somewhere in the intermountain area between the Alleghenies and the Rockies. A site of 219 acres, located ten miles north of downtown Cincinnati, beside the old Miami and Erie Canal and on the Big Four Railroad, was chosen because it offered the best combination of population with an industrial background, accessibility to transportation and sources of fuel, power and water.

Work on plant layout was started even before it was known where the plant would be located. In swift succession, land was purchased; the architect called in, sketches were made and approved. Structural steel drawings were prepared rapidly, with the architectural drawings being developed coincidentally by the architects and engineers, steel bids were taken and contract let, while the excavation plans were being completed.

Ground was broken on October 23, 1940, steel erection began on January 3, and 142 days after groundbreaking manufacturing operations were in progress. In less than eight months after groundbreaking this 50-acre plant was designed, constructed, tooled and in operation producing engines. During this period, training schools were set up to prepare for a steadily increasing flow of skilled labor until more than 12,000 men will be at work to utilize the full capacity of the plant.

This plant will produce Cyclone 14-cylinder radial air-cooled engines of 1700 hp each, swelling many times the engine horsepower output of Wright when peak operations are reached. Operations began June 12 but since April 14 machine tools have been producing engine parts.

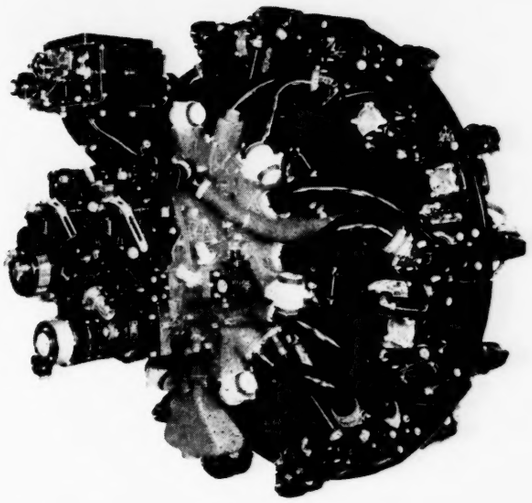
The plant consists of 2,120,000 sq ft of floor space, including the largest single-story building in the world, the largest aircraft engine plant in the United States. Sixteen major baseball teams could play in eight games simultaneously in the plant with 30,000 fans in the stands at each game, and there still would be room for a college football game on a regular gridiron with 25,000 spectators. Everything about the plant is prodigious.

The plant comprises twelve units. The principal unit is the huge Machine Shop and Assembly Building stretching over 33 acres of floor space (1,500,000 sq ft) and is 1064 ft x 1320 ft. This area is unbroken by walls or partitions except by a fire-wall to block off the Heat Treating Department. The second unit is

PROFITS IN AIR

CORPORATION'S

single story factory and largest building, with 70-zone system, 6000 tons of refrigeration.



the Aluminum Cylinder Head Foundry, located 600 yd to the south of the Assembly Building, one-story, 250 ft x 640 ft, containing 166,400 sq ft of floor area —the largest foundry of its type in the world, surpassing the combined production of the Company's two foundries in New Jersey.

To the main building is joined a two-story T-shaped reinforced concrete office and engineering building with 66,000 sq ft of floor space; and a 406 ft x 380 ft wing to provide room for 74 soundproof test cells (two groups—one for green test and the other for final test). There are also a Power sub-station 125 ft x 88 ft, a Power Plant 150 ft x 150 ft, and buildings housing carburetor testing equipment, water softening plant, oil and chip storage, a cooling tower for the refrigerating compressor, and oxygen and acetylene supplies.

The Aluminum Foundry is as automatic as ingenuity can make it. It is arranged so that production, from the time sand for molds is dumped into hoppers until the cylinder head is finished, is conducted on a straight-line basis. These cylinder heads contain the cooling fins which make the air-cooled aviation engine possible. Metal chips which drop from the cutting and grinding machines are handled automatically, cleaned of oil centrifugally, and dumped into bins that can fill a gondola car every eight minutes.

The Machine Shop and Assembly Building is a one-story structure of steel-frame construction with monitor type roof of concrete, tile and glass; reinforced concrete floors; and hollow tile exterior walls broken by a 7 ft continuous band of steel window sash. Unusually large basement space, 225,000 sq ft, is provided in the shape of a cross (with center near the center of the building) to accommodate corridors and air-conditioned cafeterias and locker rooms, thus leaving the first floor entirely free for production.

To provide for blackout, clip angles drilled for bolting 2 by 4's to them are welded onto the vertical mullions between the sash in both sidewalls and monitors. Corrugated iron sheets can be nailed to these to exclude all light from within.

Design of the plant is such that it can be expanded 200% if necessary.

Authoritative descriptions of the heating, ventilating, and air conditioning in this plant follow. The first begins on the next page.

HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF ATMOSPHERIC CONDITIONS

THE DESIGNERS' VIEWS

are summarized in this article by G. S. Whittaker, of the office of Albert Kahn, which deals with the heating, air conditioning, and other mechanical equipment in

WRIGHT AERO'S LOCKLAND PLANT

WHEN the Wright Aeronautical Corporation had decided to air condition the Machine Shop and Assembly Building of its new plant at Lockland, Ohio, the problem was to design the least expensive year-round conditioning system which would most efficiently maintain the desired conditions.

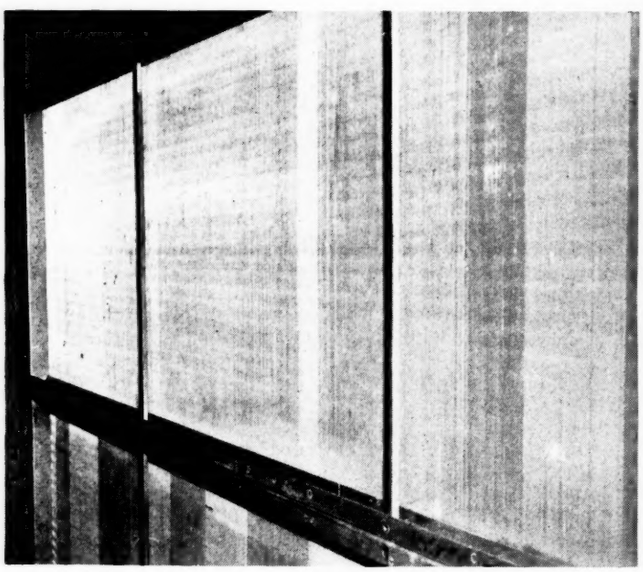
Some indication of the difficulties of the problem can be grasped when it is realized that the large one-story Machine Shop and Assembly Building encloses 33 acres of floor space without an interior wall other than a fire wall which isolates the heat treating department. One of the most difficult parts of the problem was the design of the summer air conditioning. In designing this system it was necessary to take into account, in addition to the usual heat gain due to outside air temperature, an extremely large motor load, the large sun heat load on the 33-acre roof, a very considerable human and lighting load, and a terrific load due to the heat treating furnaces.

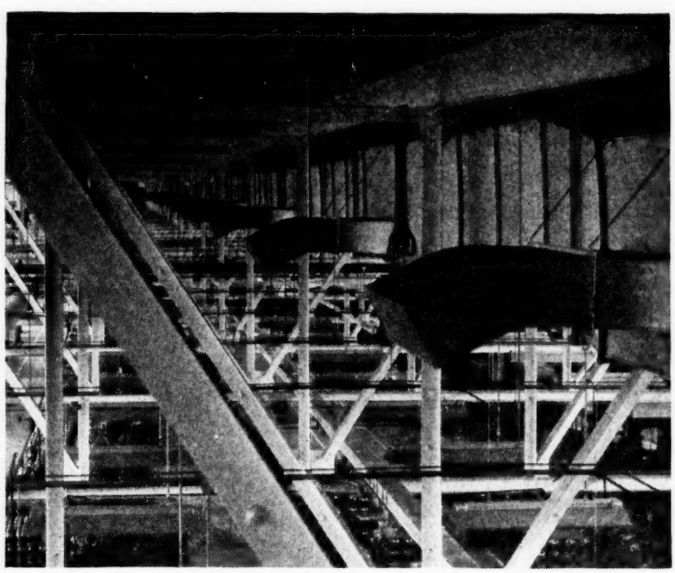
Another factor which complicated the problem was the fact that the heat gain varied considerably in the various sections of the plant. For example, in the section devoted to storage the internal load was extremely light while in the section where the heat treating furnaces were located there were very large concentrated heat loads. Allowance also had to be made for the fact that these loads were not constant but could be expected to vary, since one or a number of sections might be shut down while the rest of the plant might be working at full capacity.

In attempting to find the most economical solution many types of systems were considered. The systems considered included those which used large amounts of outside air, those employing evaporative cooling and those using mechanical refrigeration.

Systems using large amounts of outside air were ruled out primarily because it was felt that they could not maintain the desired conditions in the plant. They probably could have maintained reasonable comfort conditions but the inside temperature would have varied too much to make the accurate machining of metal parts feasible. Evaporative cooling methods were ruled out primarily because of the high relative humidity encountered in the Cincinnati region. After ruling these first two methods out the problem was then to design the most economical system using refrigeration.

Direct expansion and indirect water systems were





(Left) The Sturtevant combination heating and cooling coil used on each of the 70 conditioning units and reputed to be the largest of its kind ever produced. (Right) A view of the duct work for distributing conditioned air through the factory.

considered. While the two systems were identical in a large number of respects it was felt that the use of an indirect system would be advantageous, since with this system it was not necessary to have any refrigerant in the working areas. An investigation showed that an indirect system could provide the same conditions as a direct system at a considerable saving in cost, for with this system it would be possible to use the pipes and heat transfer coils for both summer cooling and winter heating merely by circulating hot water rather than chilled water.

To allow for the varying loads in the various sections of the plant, the floor area was divided into 70 zones and a separate year-round air conditioning unit was located in each zone. Fourteen of these units were located in the assembly department, 56 in the rest of the working area. The 14 in the assembly department differed slightly from those in the other portions of the building because of the large number of spray booths located in this area. These spray booths made it necessary to provide an air moving capacity of 36,000 cfm for each of these units. The other 56 units each circulated 30,000 cfm.

Because of the extremely large heat loads encountered in the heat treating section it was decided not to use any chilled water for cooling this section but to employ evaporative cooling instead. In these locations the air is passed through air washers and is delivered at a high velocity into the area where men are working.

The only other sections of the main building not conditioned by the main refrigerating plant are certain small areas such as First Aid Rooms and small dining rooms. It was decided not to cool these areas from the main system mainly because of cost. In these locations individual self-contained air conditioned units were installed.

To save space the 70 central air conditioning systems are located in the truss space over the manufacturing area and to eliminate floor obstructions the platforms on which the air conditioning units are located are hung from the roof trusses. To make the units accessible the platforms are connected by cat walks.

Each system has automatic air filter, combination heating and cooling coil, and blower together with necessary ductwork for distributing the air. The systems take in outside air and recirculated air in the correct proportion, clean it, heat or cool it according to the requirements as determined by an effective temperature control, and then distribute it by overhead ducts.

To provide for the most efficient operation it was felt that maximum use should be made of outside air. Therefore, a control hookup was laid out so that whenever the outside air is at a temperature low enough to off-set the internal heat gain, all outside air will be supplied to the working spaces and no recirculated air, cooling or heating will be used. As the outside temperature rises or falls the amount of outside air will be reduced until 15% of outside air and 85% of recirculated air is being supplied to the working space. At least 15% outside air is supplied at all times.

As the outside temperature rises and as the amount of outside air being brought into the building is reduced, a larger proportion of the mixed air is passed over the heat transfer coil and less is by-passed around the coil.

These operations are controlled by two instruments, one an effective temperature thermostat located in the re-circulated air intake and the other a dry bulb thermostat located in the mixing chamber just before the air goes to the heat transfer coil. The effective temperature thermostat controls the operation of the damper which allows the air to by-pass around the heat transfer coil. As the outside temperature rises, the effective temperature in the working space, and thus the recirculated air temperature, will increase. This causes the by-pass damper to close so that more of the mixed air is forced to pass through the heat transfer coil to be cooled.

As the outside temperature decreases the effective temperature thermostat causes the by-pass damper to open to allow more air to pass around the heat transfer coil.

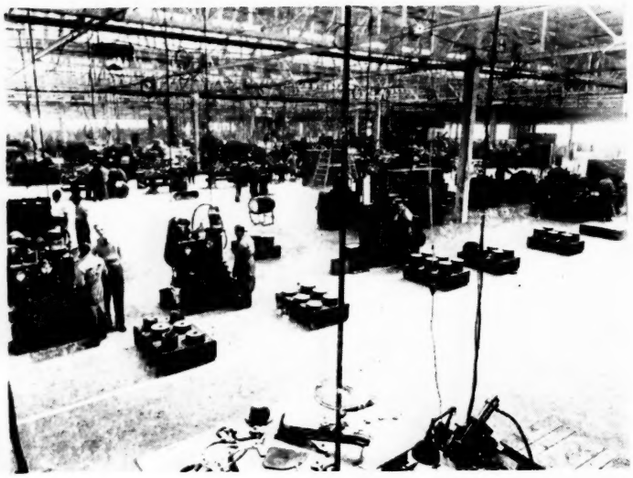
The dry bulb thermostat is located on the inlet side of the coil and is used to prevent the air temperature from rising above 85F in the summer. This is done by closing off the outside damper and opening the re-circulating air damper. The operations described all apply to summer use.

During the winter the reverse action takes place. The dry bulb thermostat during the winter operation is used to prevent the mixed air temperature from falling below 40F by closing the outside air damper and opening the re-circulating air damper.

To help ventilate the plant, particularly when large amounts of outside air are being used to maintain the proper conditions within the plant, 280 roof ventilators are provided, each with the capacity of 10,000 cfm. The operation of these roof ventilators is controlled by the dry bulb thermostats which are located in the air conditioning unit. It will be recalled that these dry bulb thermostats regulate the amount of outside air which is supplied to the air conditioning units. As the amount of outside air is increased the dry bulb thermostat causes the motors on the roof ventilators to operate and thus help ventilate the plant. It is possible to supply as much as 300,000 cfm to the main area of the plant for ventilation purposes.

Considerable attention was paid to the temperature at which the water circulates through the heat transfer coils and to the water temperature rise through

THE WRIGHT LOCKLAND PLANT WAS DESIGNED BY ALBERT KAHN ASSOCIATED ARCHITECTS & ENGINEERS, INC., IN COLLABORATION WITH WRIGHT AERO'S PLANT ENGINEERING DEPARTMENT



A view inside of the machine shop at the Wright Lockland plant. One of the unit heaters can be seen overhead at the left.

the coils. On summer operation high water temperatures enable the refrigeration compressor to operate at high suction pressures which result in increasing the capacity of the compressor. On the other hand, high water temperatures limit the temperature rise of the water which in turn makes it necessary to circulate larger quantities of water.

It was decided to operate the refrigeration compressor so as to deliver water from the coolers at 47F. This enables the compressors to operate at higher suction temperatures and thus increases their capacity from 1000 to 1200 tons. The water temperature rise in the pipes from the water cooler to the heat transfer coils was calculated to be 1F which meant that the water available at the coils was 48F. Since most of the load in the plant was sensible load, a standard coil, 4-rows deep, was selected, with an inlet water temperature of 48F and an outlet temperature of 60F. These conditions hold when the plant is operating at peak capacity with 12,000 gpm water being circulated.

During winter operation the same amount of water is circulated. The water is heated by three instantaneous heaters supplied with steam from the boilers in the boiler house.

Since very little use is made of steam during the summer months it was decided to drive the refrigerating compressors with steam turbines. Five centrifugal compressors are located in a refrigerating plant next to the main boiler plant. The five centrifugal compressors are each equipped with a steam turbine, steam condenser, refrigerant condenser, and water cooler. Compressors are rated at 1200 tons capacity each.

The water coolers are the shell and tube type and are capable of cooling 12,000 gpm of water to 47F.

This water is supplied to the main building through a 20-in. water pipe by three centrifugal pumps each with a capacity of 6000 gpm. One of these pumps is kept in reserve and is driven by a 400 hp electric motor while the other two are steam turbine drive.

In the factory building the circulating water lines are run in the truss spaces. It was necessary to use expansion joints on these lines to take up the expansion due to temperature changes since the pipe bends would have been too large. This necessitated fairly substantial anchorage and guides to keep the pipes in a straight line. In fact, the stress of these lines where they come together at the tunnel was so great that the structural engineers thought it advisable to strengthen these trusses to reduce any chance of buckling at this point.

While the 70 air conditioning units are used for heating the plant during the winter some spaces have more than average heat losses, either because they are located close to doors which are opened frequently or because they are near the outside walls of the plant. To take care of these losses individually controlled unit heaters are employed.

The areas in which supplementary heating is required include the shipping and receiving spaces where railroad cars are unloaded and the spaces around doors and outside walls.

In the shipping and receiving areas overhead projection type unit heaters are used while at the doors large blower type heaters are employed. All of these heaters have individual starters and thermostats to control their operation. The space near the outer walls of the building is heated with unit heaters spaced about 100 ft apart. These unit heaters are sized so that they take care of all of the outside wall loss which makes it possible to operate all of the large air conditioning units at approximately the same temperature. The unit heaters at the wall locations are individually controlled by starters and thermostats. The starters have three positions—*on, off,* and *automatic.* This control allows a heater to be run in the summer without disconnecting the thermostats.

All of the unit heaters are supplied with the steam at 25 lb pressure. This steam is supplied through reducing valves by a 10-in. high pressure line which is carried in a tunnel from the boiler house and is run through the trusses of the factory to serve the needs of the factory. Wherever process steam is required it is taken from the main 10-in. pressure header at a point where it is to be used.

All of the condensate from the various heating systems runs to pumping and receiving units located in the basement fan rooms, from these units up to the truss, and thence to the tunnel where it is carried back to the main receiver in the powerhouse.

While the main office, factory offices, cafeteria, and rest rooms are cooled with chilled water supplied from the water coolers in the machine room, they are heated by steam. This is done because the load in these areas differs considerably from the load in the factory portion. During cool spring and fall days the high internal load in the factory may make the factory temperature rise so that cooling will be required. Due to the fact that the internal heat gain in the offices is low on these same days, it probably will be necessary to supply some heat. By having these areas heated with steam it is possible to cool the factory portion on the cooling cycle and still provide the necessary heat to the office spaces.

AIR CONDITIONING FOR DEFENSE

THE OWNER'S VIEWS

on the heating, ventilating and air conditioning are described by H. E. Linsley, Wright Aeronautical Corp., discussing the problems involved in the planning of

WRIGHT AERO'S LOCKLAND PLANT

WITH a capacity of 6,000 tons of refrigeration, the largest centrifugal air conditioning installation ever made as a single unit is being installed in the Cincinnati (Lockland) plant of the Wright Aeronautical Corporation. So great is the area to be conditioned that the customary units of *square feet of area* become inadequate and calculations must be made on the basis of *acres* since the main machine shop alone covers more than 30 acres on a single floor and under one roof.

Investigations showed that the heat produced by the heavy concentration of personnel, by the operation of thousands of machine tools, furnaces, and other equipment, and above all, by the effect of a summer sun blazing directly upon the enormous roof area, would cause the indoor temperature to rise to the unbearable level of 140F. Work of any nature would naturally be impossible under such conditions, but even apart from this factor, air conditioning is particularly desirable when parts are to be machined and assembled to the close tolerances demanded in aircraft engine work. Limits of one and two ten-thousandths of an inch are very common in work of this kind, particularly on smaller parts. Larger parts such as crankcase sections, although not held quite so close, may vary several thousandths with changing temperatures, and be the cause of endless disputes between the manufacturing and inspection departments, not to mention the difficulties encountered when assembling thousands of different parts made under varying temperature conditions.

This huge system was designed by Albert Kahn Associated Architects and Engineers, Inc., Detroit, in close collaboration with the Plant Engineering Department of the Wright Aeronautical Corporation, and installed by Frank A. McBride, Paterson, N. J. It is so designed that the same conditioning system is employed for winter heating and summer cooling, an arrangement which effected a saving of nearly half a million dollars over the cost of separate systems. Some idea of the size of this installation may be had by the fact that there are some two and a half million pounds of sheet metal duct work, and more than 190,000 linear feet of piping, weighing about 1200 tons. The main water supply is taken from six deep wells on the plant property with a total capacity of 6000 gpm.

Heat is supplied by three enormous instantaneous steam heaters which condense 80,000 lb of steam an hour to heat to a temperature of 210F the 12,000 gal of water circulated each minute through the system. Cooling is effected by passing this same amount of water through a refrigeration system. The outlet temperature from the water coolers is 47F while the normal inlet temperature of the re-circulated water is about 59F. The conditioning units in the machine shop are attached to the ceiling and are readily accessible by means of a cat walk. A door in the side gives access to the interior of the unit for maintenance and cleaning. Louver houses on the roof for the fresh air intake are equipped with power operated louvers and are situated directly above the ceiling units. For the units in the basement, the air is led through ducts on the outside of the building, and thence through tunnels into the units. A total of 280 roof ventilators

One of the Kool-Shades installed outside the window of the executive and engineering offices. These serve the double purpose of excluding direct rays of the sun and preventing the passage of all but the smallest insects.

are provided, each with a capacity of 10,000 cfm. These are equipped with 3 hp motors and 36-inch fans, and while they are interconnected with the temperature control system, may also be operated independently through push button controls. Under normal conditions, 15% of the total air will be exhausted per minute for ventilation purposes, but if necessary, as much as 2,300,000 cfm may be evacuated through these and the various outlets from spray booth exhausts and so forth. At certain times of the year, particularly in the late spring and early fall, comfortable working conditions may be obtained by circulating air through the medium of these fans alone, without resource to either heating or cooling, especially in the early mornings and evenings.

In order to avoid excessive loads on the air conditioning system, special attention was paid to the design of the roof, which is covered with a 1-in. layer of cork topped by a 3-in. layer of crushed slag. Heat absorbing glass is used in the factory windows and skylights to partly exclude heat rays and cut down sun glare without unduly sacrificing light passage. Where clear glass is used, as in the offices, special Kool-Shades are installed. Consisting of narrow, horizontal steel strips, not unlike a venetian blind in miniature, these serve to exclude practically all the direct rays of the sun.

The entire refrigerating plant is housed in a special building adjoining the main boiler plant and is made up of five units, each of which consists of a centrifugal compressor, a steam turbine, steam condenser, refrigerant condenser, and water cooler. The compressors, supplied by Carrier Corporation, are rated at 1200 tons each. Each one handled 17,700 cu ft of Carrene refrigerant a minute and is driven by a Terry multi-stage steam turbine using approximately 15,200 lb of steam an hour. There is a decided advantage in this method of drive since it permits the economical operation of a boiler plant which would otherwise be almost, but not quite, idle. The steam condensers, supplied by the Condenser Service Company, are of the shell and tube type with 2115 sq ft of inside surface, and 7490 sq ft of outside surface. Water coolers, also by Carrier, are shell and tube type having 2350 sq ft inside area, and 8330 sq ft outside area.

The filters, made by the American Air Filter Company, are of the self-cleaning oil type in which the rotating blades pass at intervals through an oil bath where all dust is washed off and deposited in the bottom of the tank. These filters remove not only dust but also oil vapor from the circulated air.

Water for the air cooling and heating system is circulated through a 20-in. diameter main at the rate of 12,000 gpm by three Buffalo 12-in. Class S, horizontal, double suction, single stage, centrifugal pumps rated at 6000 gpm each at 1200 rpm against a 200-ft heat at 80% efficiency. One of these is driven by a Westinghouse 400 hp synchronous motor, and the other two by Westinghouse non-condensing steam turbines operating at 175 lb pressure and 30 lb back pressure, the exhaust steam from these being used in plant process. Two of these pumps are used for service and one as a standby.

In view of the fact that the main office building is situated at a distance of 1400 ft from the refrigeration plant, two separate pumps are used for circulating the water to this department. These are Buffalo 6-in. horizontal, split shell, double suction, single stage, centrifugal rated at 1500 gpm at 75% efficiency against a 200-ft head, and are driven by Westinghouse induction motors. As in the case of the main circulating system, one pump is required for normal service and one for standby.

Condenser water for both steam and refrigerant condensers is supplied at the rate of 18,000 gpm by a battery of three Buffalo 16-in. horizontal centrifugal pumps, each with a capacity of 9000 gpm against a 100-ft head at 1200 rpm and 86% efficiency, driven by 300 hp Westinghouse 440-volt synchronous motors. This water is passed first through the refrigerant condensers, and then through the steam condensers, and has a normal outlet temperature of 107F. This is reduced to 85F by passing through a Marley

A view in the Lockland plant machine shop. One of the projection type unit heaters can be seen overhead slightly to the left.

cooling tower before returning to the condensers. This cooling tower is 250 ft long, 50 ft wide, and 30 ft high, and differs substantially from the standard type in that it has been designed architecturally to blend in with its surroundings. Ten 10-ft dia fans are employed to maintain air circulation through the tower.

The hot or cold water is fed to a battery of 70 conditioning units distributed throughout the manufacturing area. Fourteen of these units are situated in the assembly department, and on account of the high loss of conditioned air through the many spray booths exhausting to atmosphere, have a capacity of 36,000 cfm each. The remaining 56 units each circulate 30,000 cfm. In the administration building there are three similar units, while another eight are installed in the factory offices and in the basement cafeterias, rest rooms, and locker rooms. They are installed in pairs with a common intake but with two outlets facing respectively East and West, and connected to long ducts through which the air is distributed. Adjustable louvers on the outlets permit directing the air flow in the desired direction. Each unit contains a combination heating and cooling coil, circulating fan, and dust filter.

The fans and coils were specially designed by Sturtevant, and the coils are reputed to be the largest ever constructed for such service. The fresh air intake is through roof louvers equipped with motor-driven dampers, while similar dampers control the intake of re-circulated air through grilles in the bottom of the mixing chamber. A control is situated in the re-circulated air intake and is so arranged that as the temperature of this returning air falls in the summer or rises in the winter, a greater percentage is by-passed around the conditioning coil. A second control governs the operation of the dampers to prevent the temperature of the mixed air from falling below 40F in the winter, or rising above 85F in the summer, and also regulates vent dampers to prevent any increase of air pressure inside the building caused by forcing in large quantities of outside air.

Only the minimum amount of fresh air needed for ventilation is admitted in the winter time, but as the temperature rises this proportion is automatically increased until heating is no longer necessary. So long as outside air alone is sufficient to offset this temperature rise the fresh air damper remains fully open, but should the temperature increase beyond the desired point, the ventilating fans in the roof automatically start up in the zone or zones affected. In the summer time also, the fresh air intakes are closed except for the minimum required for ventilation, but will open automatically to admit more hot outside air if the inside temperature becomes too low.

In the basement and office sections the air ducts are set into the ceilings, with rosette-type outlets. Return air is drawn in through parallel ducts connected directly into the mixing chamber of the units. This double duct system is rendered necessary by the fact that the units are installed on the basement floor, and that circulation is impeded by the many partition walls.

In the heat treating section, where abnormally high temperatures are encountered, air cooling is not employed. Instead, the air is washed with well water, and delivered at high humidity and high velocity into just those areas where men are working. For the conditioning of small enclosed areas such as the First Aid Rooms and Executives' dining rooms, it was not found economical to install special small units with the attendant vast amount of piping, and in these places individual Chrysler Airtemp units have been installed.

Controls are by Johnson Service excepting for the Cutler-Hammer pressurestats and relays and Minneapolis-Honeywell thermostats.

A view showing three of the four American rotary filters in each of the 70 year round air conditioning units in the Wright plant.

Fans, Fan Drives and Control for Vehicular Tunnel Ventilation

By F. F. KRAVATH†

In previous installments of this three-part series on vehicular tunnel ventilation, the author has treated the analysis and methods of ventilating such tunnels, and presented information on the details of duct connections. In this, the concluding article of the series, the author takes up the matter of fan selection and the very important question of fan drives. He concludes the discussion of atmospheric control and matter of moisture removal from tunnels.

Fan Drives

INGENUITY can have a field day when it comes to devising the various methods of driving the fans necessary in the delivery and exhaust systems. However, it is wise to consider every possibility since flexibility, economy of operation, and a minimum of maintenance requirements hang in the balance.

The simplest drive of all is, as illustrated in Fig. 11c, a directly coupled arrangement between fan and motor with the motor raised on a pedestal to the proper centerline height. With the use of a flexible coupling to minimize starting shock, such a drive, representing a minimum initial investment in equipment and having a minimum of parts to maintain and subsequently replace, should be used wherever possible.

In the use of alternating current, with the exception of certain few makes, motors are limited to the synchronous speeds determined by the frequency and the number of poles of the motor. Thus the synchronous speeds for 60-cycle current are 3600 fpm, 1800, 1200, 900, 720, and generally 600. Also, due to load these speeds are generally reduced around 3 to 4%. Using 25 cycle current, the synchronous speeds would be 1500 rpm, 750, and 500.

In general, there are three distinctly different types of blowers: those with forward curved blades, backward curved blades, and the straight or radially bladed fan.

The forward curved blade fan will generally handle the greatest volume of air for any desired fan size or initial investment. It is capable of withstanding a resistance of as high as 5 in., which is more than sufficient for tunnel ventilating purposes—where the system is well designed. It is also capable of attaining very satisfactory efficiencies. However, in spite of these advantages and the important one of being able to handle a given volume of air against a stated resistance at a lower speed than the backward curved blade fan, its construction is most generally not as rigid and husky as the faster operating fan.

The backward curved blade fan is the most efficient type of all. It is the most rigidly constructed and the quietest operating. Although the most expensive of the three types, it should be chosen wherever possible since it will give the most trouble-free service.

The straight bladed fan has little use in tunnel ventilation since its efficiencies do not match those of the curved blade fans. Since it is the slowest fan of all, generally being built tall and narrow, its capacity is definitely limited. We, therefore, find that we can use either the forward curved or the backward curved blade fans.

Another point for consideration is that while any given fan, regardless of type, may have quite a useful range of operation as regards capacity and pressure, it has a point where its efficiency reaches a maximum. A fan operating at a point other than this maximum efficiency is wasteful of power. In a tunnel ventilating system where the power under most favorable conditions will be huge, any wasteful condition is magnified and should not be tolerated. All the fans of a particular series or type will generally have the same maximum efficiency. The best operating point for each will occur at a capacity and pressure commensurate with the fan's size. Thus there will rarely be more than two fans of any type, of a given make, which will present themselves for choice. As explained, capacity and pressure will generally limit the most efficient choice to a single size (or at most two) of any type.

Besides blade forms, fans are also classified into single inlet or double inlet, single width or double width. While fans are occasionally built single width and double inlet, they are generally built as single inlet, single width or double inlet, double width. These two types will have similar characteristics with the exception that the double width fan will handle almost twice the air volume of the single width fan against the same pressure, at the same speed, and with twice the horsepower consumption. The efficiency is only slightly lower in the case of the double width fan, probably due to a slight impact of air columns at entry into the fan, and it is recommended that this fan be used wherever possible, since it will rarely cost more than 35 to 50% more than the single width fan and do the work of two.

Returning again to the directly coupled fan and motor, we now see more clearly why the use of such an arrangement is limited. We must have coincidence between the synchronous motor speeds and the speeds of particular fans at which the desired capacity and pressure can be handled not only the most efficiently for "the" fan, but for "any" fan.

Where the direct-coupled arrangement cannot be used, resort must be made to other means, among these being belting, gearing, or sprockets and chain. Gearing is the least flexible arrangement, will call for the most nearly perfect alignment, and will necessitate an

†Lieutenant (JG) Civil Engineer Corps, USNR.

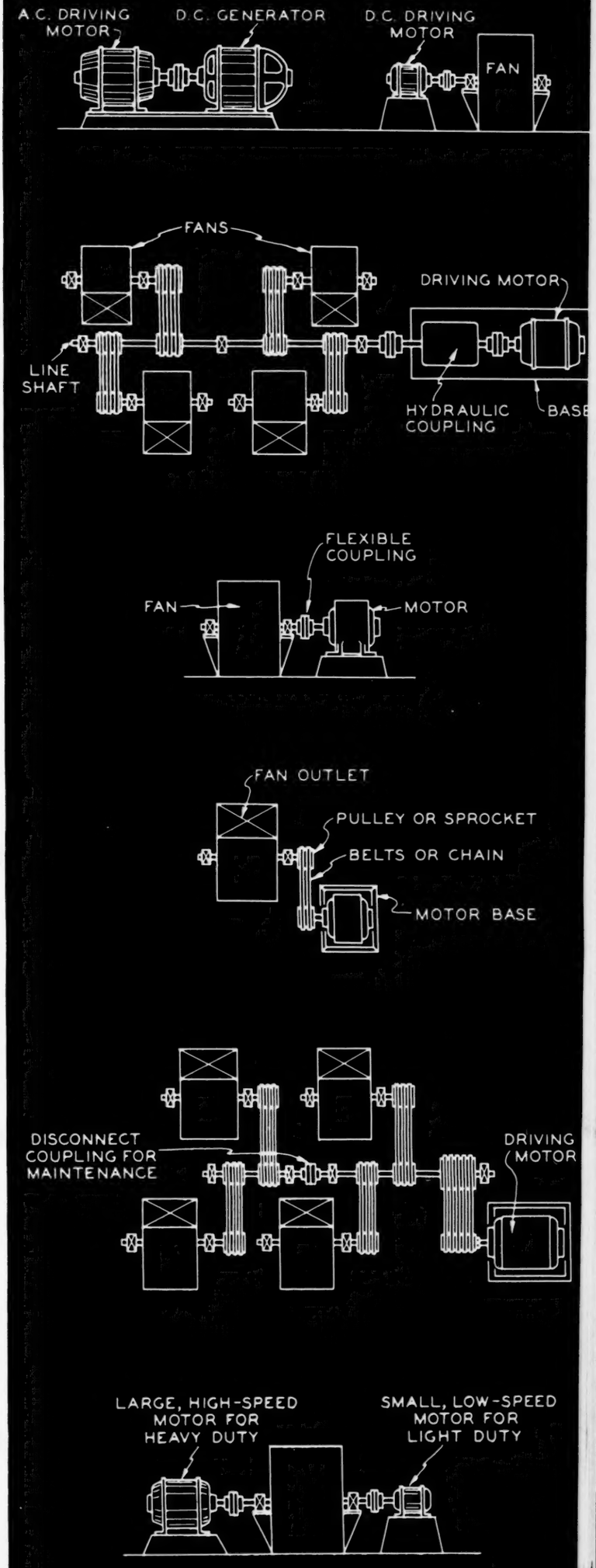
Fig. 11. Speed fan drive for variable load.

intimate mounting between fan and motor so as to bring the gears close enough to mate since larger gears cannot be used at the speeds which will prevail. Since such an intimate mounting is not desirable, and the cost of aligning the two units would be more expensive, resort is usually made to one of the other two means —belting or chain.

In the use of belts, either the flat leather or rubber belt may be used or the V-belt. The flat belt use will allow the use of plain flat pulleys, while the V-belt use will necessitate the use of grooved pulleys to match the belts. Where a flat belt is used, an automatic tension-controlled motor base should be used. Thus, stretch in the belt will be immediately taken up automatically by the base and no slippage with resultant drop in capacity will result. In the case of the V-belts, while an automatic motor base is advantageous, it is not absolutely necessary since extra gripping is secured by "bulging" of the sides of the belt around the pulley contact surface. Smaller pulley sizes may be used in the case of the V-pulleys resulting in a more compact arrangement. This is the preferred arrangement of the two.

Belts, in general, are a high speed drive and cannot be used where the belt speed becomes low to transmit any appreciable torque per unit of contact surface. Slippage occurs, decreasing performance and deteriorating the drive. Where extremely large fans are used the fan rpm is bound to be low in order to keep the peripheral speed of the fan wheel from becoming excessive. In these cases, economical belt drives will generally be ruled out since the low speed will necessitate many belts and large pulleys in order to transmit the necessary torque. A more economical drive and a better drive in such cases is the sprocket and chain drive. (Both types are illustrated schematically in Fig. 11d.) No slippage can occur with a chain drive regardless of how low the speed becomes. Sufficient flexibility of operation is secured due to the sag in chain length of the top portion of the chain and the nature of the chain linkage itself. Due to the fact that the chain must run in oil, the drive will be cool and generally long-lived and trouble-free. One advantage of the belted or chained drive is that a change in operating characteristics can be secured easily by a change in one of the pulleys or sprockets.

Illustrated in Fig. 11e is a group drive. Here, a single large motor is used to drive four (or as many as desired) fans. While the illustration shows the motor and fans connected to the lineshaft by belts, connection of either or both can be made equally well by chain and sprockets. Such an arrangement possesses many possibilities. One decided advantage it has is in the saving of equipment since only one instead of four motors are now necessary. Starters and the necessary wiring and switching equipment need be supplied for only one instead of four motors and while it is true that the single motor will have to do the work of four smaller motors, it need not necessarily be four times as large as the smaller motor, nor will it or the necessary electrical equipment cost anywhere near four times



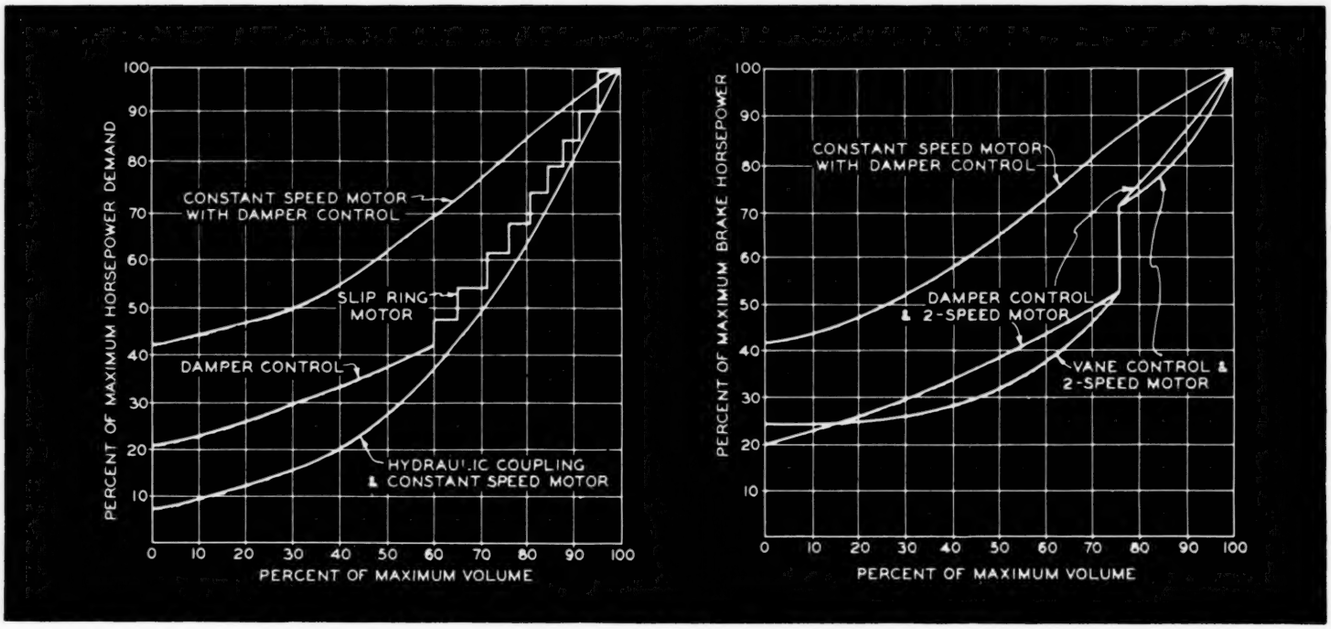

PERCENT OF MAXIMUM HORSEPOWER DEMAND
CONSTANT SPEED MOTOR WITH DAMPER CONTROL
SLIP RING MOTOR
DAMPER CONTROL
HYDRAULIC COUPLING & CONSTANT SPEED MOTOR
PERCENT OF MAXIMUM VOLUME
PERCENT OF MAXIMUM BRAKE HORSEPOWER
CONSTANT SPEED MOTOR WITH DAMPER CONTROL
DAMPER CONTROL & 2-SPEED MOTOR
VANE CONTROL & 2-SPEED MOTOR
PERCENT OF MAXIMUM VOLUME

Fig. 12. Comparative results of different methods of volume regulation.

as much. The base or foundation for the larger motor and the mounting of it will generally cost little more than would be the case for any one of the smaller motors. A decided space saving is possible with an arrangement as illustrated.

Against the equipment which can be eliminated, we must use a lineshaft, necessary floor stands and braces, and at least three bearings. By the use of such an arrangement, a smaller, but higher speed motor may be used to drive the lineshaft and the fans may be operated at their most efficient speed by proper belting. Perhaps the sole bad feature of the whole arrangement is the lack of flexibility, and the more desirable the group drive is from the space saving and equipment saving aspect, the less desirable it is from the flexibility angle. In order to stop one fan, all must be stopped. If trouble develops within a fan, everything must be shut down at least until the belts may be slipped off the lineshaft sheave. If trouble develops within any of the lineshaft bearings, the entire unit must stay down until replacement is made. This should not happen often and in any event is no more of a probability than the same condition occurring within the bearings of any of the smaller motors replaced.

By the use of clutches, each fan can be thrown on when and if desired without affecting the other fans. Such a set-up is not recommended since the cost of clutching equipment, greater number of bearings, longer lineshaft, added space, and the maintenance increase caused by the increased equipment would nullify most of the saving to be made otherwise. In any event a balance must be struck between the initial savings to be made with the use of a group drive and the lack of flexibility which will be occasioned by the use of an excessive number of units in the drive.

Another set-up would use a motor-generator set as shown in Fig. 11a. Here, assuming direct current is not available, alternating current is used by the driving motor to turn the direct current generator at the desired speed. Then, through the proper panel board and switching equipment, the direct current generated is used by the smaller d-c fan driving motors to turn the fans at the exact speed desired. With the use of both armature and field control of the current flowing, excellent speed regulation may be secured. This may be used to secure the exact initial speed desired and to reduce or increase the speed of the motors and fans to match the requirements of tunnel vehicular traffic. Such a set-up obviously involves the use of much costly equipment. It also has the disadvantage of using three driving machines instead of one. Thus the overall efficiency from a power-using standpoint will be the product of the individual efficiencies. An average a-c or d-c motor running at full load will generally have an efficiency around 85%. A direct current generator will be about the same. So, against the efficiency of 85% for the single motor, we will have 85% $\times$ 85% $\times$ 85% $=$ 61.2%. The effect of a lagging power factor will be the same for the small a-c fan motor as it will be for the larger set motor, and in any event can be taken care of in exactly the same manner (by the use of synchronous motors or by the use of condensers). With more efficient motors, such a set-up becomes more practical. With a motor and generator efficiency of 90%, an overall efficiency of 73% may be obtained.

One of the greatest advantages of this sort of drive is, as previously mentioned, the ease with which variation in tunnel load may be obtained. It will be rare indeed that any tunnel will be heavily loaded throughout the entire day and night. Some means must be available to reduce the volume of air flowing during the lighter loaded periods. With the arrangement of Fig. 11c, three resources are open—dampering, use of a fan with inlet vanes and adjustment of these vanes, or the shutting off of individual units. The same is true for the arrangement of Fig. 11d. The arrangement shown in Fig. 11e can use dampering and inlet vane adjustment, but in order to stop any single unit, the whole group would have to be stopped. Thus, we can see that the method of Fig. 11a is the most flexible of all,

and in spite of a lower efficiency at full load, it has a higher efficiency at part load.

The arrangement shown in Fig. 11b has all the attributes of the group drive, all the flexibility of the motor-generator set, has none of the bad points of damper control and is, generally, the most satisfactory sort of drive that can be hooked up for tunnel ventilation service where great variation in vehicular traffic is a condition of everyday operation. It utilizes the group drive of Fig. 11e and has a motor - hydraulic coupling set directly coupled to the lineshaft. The motor runs at constant speed. The fans run at whatever speed is necessary to give sufficient airflow for adequate ventilation.

The hydraulic coupling, similar to the coupling which has been featured on a couple of motorcars for the last two years is nothing more than a clutch. Two mating but otherwise unconnected plates are grooved radially. Oil, the driving medium, is forced between the plates in controlled quantities by a gear pump. One of the plates, the driving plate, always runs at motor speed. The driven plate, connected to the line-shaft, is forced in the same direction as the driving plate by the oil which enters close to the center of the plates and is forced toward the periphery by centrifugal force. The more oil flowing, the closer the driven plate approaches the speed of the driving plate. This is the basic principle. Different makes will have slight variation which will give them individual advantages. They all are alike in that they are variable speed devices and that they have very satisfactory efficiencies. A dependable hydraulic coupling is rather expensive, which makes its use with individual motors extravagant. However, with a group drive as shown, or where very large fans requiring very large motors (100 hp and over) are used, one fan driven through a hydraulic coupling can provide the variation in airflow necessary so that direct driven fans can then be stopped one by one without compromising efficiency.

The slip-ring motor finds widespread use as a variable speed alternating current motor, but its speed regulation is not as favorable as the direct current motor and it is not generally used for heavy-duty, continuous work. It is, however, a possibility and as such should be considered. It can be hooked up as shown in any of the arrangements of Figs. 11c, 11d or 11e.

An arrangement which has been used on a couple of tunnel ventilating systems to date but which is rather costly is one such as shown in Fig. 11f. Here, a fan is provided with extended shafts so that connection may be made through flexible couplings to motors at both ends. Both motors are alternating current, constant speed motors, but the speeds of the two motors differ. The larger motor drives the fan at *full speed*, that is, the speed at which the fan is delivering the air volume necessary for maximum vehicular concentration. The smaller motor drives the fan at a reduced speed so as to deliver about half the maximum volume. Thus, the steps between individual fan shut-downs can be cut in half. By the use of two-speed motors, the same thing can be accomplished, but not quite so efficiently. By the use of two two-speed motors still greater speed regulation can be secured. By the combined use of multiple motor speeds and damper regulation, rather efficient volume regulation may be secured. By the combined use of inlet vane regulation and even a minimum of speed regulation, equally efficient results may be obtained. If we increase our speed regulation, the inlet vane method of controlling air volume becomes definitely the more efficient method.

However, as previously explained, the most efficient method of regulating air volumes is by hydraulic coupling between fan and motor. In any event, the designer must balance the advantages and the disadvantages of each method against the relative cost of each method. The size and nature of each individual job will help point out the most logical choice. Fig. 12 gives some interesting comparative data on the constant speed motor with damper control, the slip-ring motor with damper control beyond its speed regulating range, and the hydraulic coupling utilizing a constant speed motor. The fan used in all three cases is the same.

Atmospheric Control

By the mounting of several carbon-monoxide measuring instruments, of which there are a number of excellent makes available on the market, throughout the tunnel proper, an accurate indication of the atmospheric pollution may be obtained. Several tests should be run as soon as the tunnel ventilating system has been completed. One test should measure the effectiveness of ventilation at several points throughout the length of the tunnel, all of the instruments being placed at about the breathing level of the average vehicle operator. These tests should be recorded for final evaluation on a comparative basis, therefore accurate and complete data should be observed and taken. Of especial importance is the recording of the station at which the readings were taken. The instruments should be placed close to both entrances, at the middle, close to the junction of delivery or exhaust duct with the tunnel ducts, and at points between the entrance and these junction points. In such a way, any adjustment necessary between tunnel portals will be strikingly disclosed. Again, tests should be run at various points to determine the area of greatest monoxide concentration within the tunnel cross-section. This will help to indicate the safest mounting point for these instruments when finally put into service. While this will be nominally near the tunnel ceiling, different designs and operating conditions may cause the area of greatest pollution to vary in position somewhat.

The instruments should be made accessible to patrolmen on duty who can make readings periodically and phone the results up to the control rooms in the fan houses. They can be electrically connected so as to either *read* on a meter in the control room or even automatically control the volume of air being circulated; however, the latter is not recommended. Since a certain amount of preventive maintenance will have to be done at all times, it is safer to have the operator attending to these duties also take care of proper amount of air to be supplied the tunnel at all times, as indicated by the monoxide meter. Meters should be mounted in the control room indicating at all times

the volumes of air flowing in both the delivery and exhaust risers, thus hairline control can be attained. In fact, in addition to the instantaneous meters mentioned, there should be at least one meter of the 24-hour recording type for the carbon-monoxide concentration, the fresh air volume, and the exhaust air volume.

The means of varying the air volume will, of course, depend on the drive arrangement provided. With the slip-ring or direct current motors, speed regulation can be secured manually by adjusting a rheostat. The hydraulic coupling is adjusted by turning a valve, thus adjusting the oil supply from the pump to the coupling. The constant or two speed motors will be started by push-button and compensator and stopped by push-button. In the case of the inlet vane fans, control is manual as it is with damper control, although both of these operations can be performed by small motor-reducers.

Where volume control is secured by the individual stopping and starting of motor-fan sets, since there will invariably be more than one fan supplying or exhausting air to and from the tunnel, it is necessary that back-flow damper regulators (check valves) be installed near the discharge of each fan for the fresh-air fans and near the inlet of the exhausting fans to prevent airflow through the stopped fans caused by the pressure differential, due to the running fans.

Moisture

While the problem of eliminating moisture which may collect in the tunnel is not a ventilation problem, it nevertheless will be a part of the mechanical designer's job, and as such should be mentioned here.

The elevation of the roadway at the tunnel portals is generally lower than the existing grade, and will generally slope toward the tunnel. Thus, any rainfall falling on this portion of the roadway will tend to be washed down into the tunnel, unless existing drainage facilities are available at a lower elevation than the roadway at the elevation of the tunnel portals. Since this is not usually the case, and since there will be a certain amount of seepage through the concrete tunnel lining (an appreciable amount of water will be brought in by vehicles during a rainstorm also) it is best to provide a means of getting rid of this moisture. Accordingly, a drainage basin or sump should be provided at the point of lowest elevation within the tunnel, and sump pumps installed of sufficient capacity and head to force the water either to the surface for discharge or through the tunnel shell, up to the river bed. The latter is not recommended since it will generally be too expensive to install. Where a tube is merely laid on the river bottom, this method will probably prove the cheaper.

For safety, duplex sump pumps should be installed, each pump of which is capable of carrying the maximum load condition. Automatic float switches should be provided which will start the pump when the water level in the sump gets high and stop it when the level gets low. For added safety, a second switch should be provided which will start the second pump if the water level gets more than a few inches beyond the normal high level. Alternators which rotate the operation of the pumps so as to prevent rust from disuse, undue wear from continuous use, or burned-out bearings or motors from the same condition are also worthwhile safety devices and generally will repay in good operating conditions many times its original cost.

This study has attempted to point out many of the practical considerations which will be met in tunnel ventilation design. It is not a story of any particular system, but rather a guide for the design of almost any. The information contained herein is based on actual experience gained by the author in ventilating and mechanical design for tunnels and otherwise.

Eggs Kept at 60F and 85% in Conditioned Auction Vaults

Broadened use of air conditioning by the poultry industry may be stimulated through interest created by the dedication Sept. 11 of a new egg and poultry auction market building at the Tri-County Farmers' Cooperative Auction Market, Hightstown, N. J., where eggs are kept fresh and perfectly flavored in a vault equipped with temperature and humidity control.

The freshness of a normal egg is largely determined by the size of the air space at the large end. As the egg ages and its original content of moisture is reduced by evaporation, the air cell becomes larger. New Jersey's "Fresh Egg Law," enforced by the State Department of Agriculture, which supervises inspections at the auction markets, requires that this cell be no deeper than one-quarter of an inch if the egg is to be sold or advertised as fresh. Humidified air of proper temperature reduces the rate of evaporation, keeping the air cell small and maintaining the most desirable consistency of the egg white.

Consequently, air conditioning will provide an extra safeguard of the auction market's "protective custody" during the interim between delivery by the farmers and sale to the distributor who rushes the eggs to his trade. Actually, eggs will be held only 24 to 48 hours at a constant temperature of 60F dry bulb and 85% relative humidity.

The eggs are collected immediately after they are laid, and placed in electrically-operated coolers that remove the body heat. Some farmers have constructed underground temporary storage vaults in which they keep the eggs until time to go to market. Circulating air is humidified artificially to make up for deficiencies in its moisture content in these farmers' egg vaults. Deliveries from the farm to the auction market are made twice weekly, usually on the mornings of the two sales days each week.

At the market, these farm-fresh eggs are placed in the air conditioned atmosphere of the new egg vault immediately after inspection by State Department of Agriculture agents.

DEGREE DAYS (65F BASE) FOR RECENT HEATING SEASONS

Degree day data by months for the heating seasons from 1927 to 1936 for a large number of cities appear in the Degree-Day Handbook. On this Reference Data sheet and on Reference Data sheet 211-212, are presented similar data for the same cities for the heating seasons since 1936.

Heating Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
ALBANY, N. Y.											
1936-37.....	110	401	841	1021	989	972	1043	560	146	5	6088
1937-38.....	164	435	698	1126	1313	997	801	438	234	32	6238
1938-39.....	210	387	754	1135	1332	1127	1138	686	196	35	7000
1939-40.....	162	504	894	1176	1549	1248	1183	698	218	87	7719
1940-41.....	173	593	807	1127	1447	1166	1150	408	227	44	7142
ATLANTA, GA.											
1936-37.....	—	90	454	555	389	570	449	191	29	—	2727
1937-38.....	19	228	502	659	663	380	217	152	14	1	2835
1938-39.....	17	80	330	650	577	425	287	186	42	—	2594
1939-40.....	3	105	420	577	1109	663	469	210	58	—	3614
1940-41.....	41	62	401	534	658	709	584	88	25	—	3102
BALTIMORE, MD.											
1936-37.....	28	195	587	751	667	792	718	354	49	—	4141
1937-38.....	61	283	519	841	896	690	496	284	103	8	4186
1938-39.....	36	189	449	791	838	651	623	367	99	1	4044
1939-40.....	13	227	531	749	1208	798	773	442	95	2	4838
1940-41.....	49	296	498	685	940	866	771	213	61	8	4387
BIRMINGHAM, ALA.											
1936-37.....	—	74	417	498	290	530	406	136	16	—	2367
1937-38.....	7	186	449	603	596	298	156	140	7	—	2442
1938-39.....	9	64	323	588	479	368	240	164	14	—	2249
1939-40.....	—	100	385	504	1068	611	359	150	42	—	3219
1940-41.....	26	43	355	445	569	633	509	42	13	—	2635
BOSTON, MASS.											
1936-37.....	122	338	769	932	854	891	954	595	210	35	5700
1937-38.....	128	387	631	1046	1150	964	802	496	291	51	5946
1938-39.....	114	295	564	959	1147	920	987	640	296	62	5984
1939-40.....	89	352	727	981	1303	1029	990	642	269	75	6457
1940-41.....	111	450	664	953	1228	998	981	409	199	61	6054
BUFFALO, N. Y.											
1936-37.....	122	420	904	968	1010	1020	1151	658	318	50	6621
1937-38.....	181	528	768	1149	1261	1019	845	585	307	62	6705
1938-39.....	181	367	650	1045	1201	1055	1075	777	304	54	6709
1939-40.....	138	404	812	1014	1454	1163	1177	744	370	106	7382
1940-41.....	137	502	774	996	1258	1157	1203	501	324	69	6921
CHICAGO, ILL.											
1936-37.....	63	363	815	964	1184	1079	997	554	263	71	6353
1937-38.....	120	443	825	1188	1230	853	623	456	248	25	6011
1938-39.....	89	235	648	1112	1039	1051	838	604	192	32	5840
1939-40.....	52	324	702	930	1511	1038	1016	614	361	52	6600
1940-41.....	106	245	792	977	1145	1104	1018	396	172	55	6010
CINCINNATI, OHIO											
1936-37.....	49	285	747	846	821	882	828	368	142	8	4976
1937-38.....	103	376	704	1025	1010	684	502	289	124	3	4820
1938-39.....	58	228	534	885	848	825	620	440	99	6	4543
1939-40.....	15	255	660	855	1426	928	771	455	203	9	5577
1940-41.....	95	193	637	779	996	968	863	227	94	4	4856
CLEVELAND, OHIO											
1936-37.....	77	346	784	888	904	953	1034	535	208	24	5753
1937-38.....	134	453	729	1081	1118	873	675	459	221	20	5763
1938-39.....	91	289	560	974	1005	919	856	592	186	19	5491
1939-40.....	65	314	695	903	1410	1058	1056	657	303	42	6503
1940-41.....	119	348	695	877	1097	1076	1068	413	177	24	5894
COLUMBUS, OHIO											
1936-37.....	53	309	797	872	841	915	884	420	148	7	5246
1937-38.....	112	409	743	1057	1047	759	562	341	139	3	5172
1938-39.....	57	260	593	931	922	871	702	507	109	9	4961
1939-40.....	21	292	683	904	1466	964	849	516	224	15	5934
1940-41.....	106	265	694	810	1036	1016	938	247	120	8	5240
DENVER, COLO.											
1936-37.....	148	471	697	887	1450	881	859	534	199	140	6266
1937-38.....	69	348	733	964	935	780	693	477	288	31	5318
1938-39.....	53	288	840	965	979	1098	766	466	154	28	5637
1939-40.....	61	323	637	747	1264	853	687	513	190	38	5313
1940-41.....	71	284	813	915	950	778	864	547	158	98	5478
DES MOINES, IA											
1936-37.....	62	402	850	1065	1564	1219	959	480	111	26	6738
1937-38.....	90	423	895	1255	1313	927	600	417	181	3	6104
1938-39.....	70	186	785	1127	1060	1218	848	486	61	15	5856
1939-40.....	77	333	704	963	1694	1152	975	506	200	—	6604
1940-41.....	81	175	882	1077	1223	1137	895	301	69	28	5868

Published by Heating and Ventilating, *148 Lafayette St., New York* 11/41

Copyright, 1941, by The Industrial Press

DEGREE DAYS (65° BASE) FOR RECENT HEATING SEASONS

Heating Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
DETROIT, MICH.											
1936-37.....	105	429	886	1012	1094	1031	1061	607	243	37	6505
1937-38.....	178	519	798	1196	1262	944	729	512	220	32	6390
1938-39.....	139	329	668	1077	1153	1068	976	625	185	26	6246
1939-40.....	108	399	788	980	1431	1110	1128	662	301	40	6947
1940-41.....	131	407	805	1021	1204	1111	1068	393	176	33	6349
DULUTH, MINN.											
1936-37.....	221	800	1240	1485	1915	1487	1322	842	440	164	9916
1937-38.....	286	741	1120	1588	1747	1310	1002	779	548	172	9293
1938-39.....	227	482	1141	1527	1543	1648	1315	896	461	247	9487
1939-40.....	267	680	878	1192	1764	1346	1376	839	533	230	9105
1940-41.....	188	504	1175	1431	1602	1419	1265	628	397	222	8831
EL PASO, TEX.											
1936-37.....	36	111	434	562	705	441	378	80	8	—	2755
1937-38.....	—	41	297	548	557	314	239	134	10	—	2140
1938-39.....	—	36	452	513	598	600	218	82	5	—	2504
1939-40.....	—	72	404	484	696	420	208	93	5	—	2382
1940-41.....	—	58	422	452	567	333	349	152	15	—	2348
ERIE, PA.											
1936-37.....	86	363	823	918	938	963	1075	591	234	23	6014
1937-38.....	154	480	744	1112	1182	935	754	497	264	34	6156
1938-39.....	124	297	593	1003	1068	975	949	647	204	24	5884
1939-40.....	95	344	745	922	1427	1102	1105	693	293	58	6784
1940-41.....	125	422	710	910	1134	1102	1120	452	212	52	6239
EVANSVILLE, IND.											
1936-37.....	18	213	676	774	834	818	693	286	68	1	4381
1937-38.....	48	298	629	939	940	549	368	219	58	—	4048
1938-39.....	36	124	480	845	746	779	502	345	61	—	3918
1939-40.....	12	173	591	814	1411	858	651	342	128	—	4980
1940-41.....	81	171	632	750	927	935	777	205	74	5	4557
FORT WAYNE, IND.											
1936-37.....	83	373	845	987	1082	1034	993	510	193	29	6129
1937-38.....	156	472	838	1183	1201	867	656	440	191	19	6023
1938-39.....	82	285	665	1062	1042	1010	833	600	132	25	5736
1939-40.....	71	360	754	990	1564	1057	1021	584	275	16	6692
1940-41.....	123	300	800	957	1167	1114	1013	352	169	32	6027
GRAND RAPIDS, MICH.											
1936-37.....	111	461	871	1014	1132	1059	1046	578	203	48	6523
1937-38.....	164	506	814	1192	1277	964	713	514	243	24	6411
1938-39.....	129	283	663	1074	1129	1063	958	641	166	30	6136
1939-40.....	108	398	744	964	1395	1098	1118	620	305	46	6796
1940-41.....	135	382	817	1027	1203	1131	1081	363	162	30	6331
HARTFORD, CONN.											
1936-37.....	100	371	784	929	904	897	980	538	141	6	5650
1937-38.....	154	423	666	1050	1189	938	748	436	237	29	5870
1938-39.....	126	271	628	1013	1166	941	958	586	174	19	5882
1939-40.....	96	387	760	1012	1416	1080	1044	638	221	77	6731
1940-41.....	149	525	712	1006	1282	1036	1033	378	199	45	6365
INDIANAPOLIS, IND.											
1936-37.....	61	298	770	904	986	967	871	432	148	17	5454
1937-38.....	109	398	769	1103	1102	764	548	358	148	6	5305
1938-39.....	65	221	579	954	906	891	667	469	96	14	4862
1939-40.....	32	260	672	898	1495	950	839	480	216	7	5849
1940-41.....	87	178	701	847	1046	1033	887	233	106	7	5125
KANSAS CITY, MO.											
1936-37.....	51	276	674	811	1305	947	782	348	62	16	5272
1937-38.....	35	290	761	1044	1021	751	406	307	108	—	4723
1938-39.....	40	121	614	898	820	996	598	359	28	1	4475
1939-40.....	35	191	636	795	1616	937	697	362	100	5	5374
1940-41.....	58	86	722	859	1013	931	754	207	27	5	4662
LOS ANGELES, CALIF.											
1936-37.....	—	25	37	203	535	266	216	108	77	8	1475
1937-38.....	—	19	106	115	128	233	231	134	80	25	1071
1938-39.....	—	27	97	138	253	305	260	104	79	7	1270
1939-40.....	—	17	21	80	166	167	133	115	29	11	739
1940-41.....	—	32	91	156	226	175	151	177	27	14	1049
LOUISVILLE, KY.											
1936-37.....	25	232	697	786	771	816	725	301	93	3	4449
1937-38.....	71	320	652	948	953	584	403	232	70	—	4233
1938-39.....	39	172	496	839	757	752	520	363	71	1	4010
1939-40.....	8	186	614	822	1382	861	683	359	159	2	5076
1940-41.....	69	132	555	701	896	903	761	178	68	1	4264
MEMPHIS, TENN.											
1936-37.....	1	145	505	582	639	624	532	153	18	—	3199
1937-38.....	19	204	477	696	715	382	186	138	9	—	2826
1938-39.....	12	71	384	655	560	550	297	204	28	—	2761
1939-40.....	8	113	453	572	1176	686	420	196	36	—	3660
1940-41.....	31	45	409	514	673	700	547	76	10	—	3005
MILWAUKEE, WIS.											
1936-37.....	89	473	885	1048	1300	1146	1050	668	313	103	7075
1937-38.....	145	505	875	1243	1338	952	731	543	330	52	6714
1938-39.....	113	290	732	1168	1129	1172	935	648	266	42	6495
1939-40.....	94	387	718	967	1530	1088	1122	707	396	78	7087
1940-41.....	134	307	862	1099	1225	1180	1104	476	236	92	6715

Published by Heating and Ventilating, *148 Lafayette St., New York* 11/41
Copyright, 1941, by The Industrial Press

H. & V.'s REFERENCE DATA — 210

How Much Fuel Can be Saved by Lowering Inside Temperatures

By CLIFFORD STROCK

FUEL conservation is always a matter of concern to building operators but in normal times is of no particular national import. However, at the present time, since there is a fair likelihood of a scarcity of oil in certain sections of the country due to the transportation shortage, oil conservation measures are being urged as a defense measure.

Among the conservation methods under consideration is that of maintaining slightly lower inside temperatures in buildings to reduce fuel consumption. This immediately raises the question as to how much fuel will be saved in a given installation for every degree lower temperature maintained inside below the standard 70F. Widely varying estimates of this have been made and the validity of the higher figures showing possible savings has been questioned. It is the purpose of this article to show that the savings are probably somewhat higher than ordinarily believed, and also to show the relationship of this saving with geography, for the saving is not a constant figure throughout the country but varies widely depending on the local climate.[1]

Inside Temperatures

Particularly in residential heating, internal heat gains such as body heat, that from lights, gas stoves, and so on, as well as external heat gains such as sun light, are ordinarily neglected. This being the case, the heat load in residential buildings is generally considered to be one entirely of heat loss and infiltration, both of which are directly proportional to the temperature difference between the inside temperature of the building and that prevailing outside. In the design of the heating plant this temperature differential is multiplied by the unit heat loss (or unit infiltration) to determine the maximum capacity necessary. This maximum capacity, though, does not measure the fuel consumption, which depends on the *average* temperature differential existing throughout the period under consideration. For a whole heating season the differential is that between the *average* temperature maintained on the inside during the whole heating season and the *average* temperature prevailing on the outside during the whole heating season. Before computing any saving, it is necessary to determine just what this temperature differential is for the usual condition when maintaining 70F inside.

Since the heat loss during the whole heating season is proportional to the difference between the average inside and average outside temperature it can be said that the fuel consumption is also proportional to the same temperature differential if we assume the efficiency of the heating plant to be approximately constant throughout the period.

Experience has shown, and the idea has been substantiated by numerous tests, that when fuel consumption is plotted against daily mean temperatures the fuel consumption reaches zero at somewhere in the neighborhood of 65F. The whole theory of the degree day method of calculating fuel consumption is based on this relationship.

If it is true, then, that the heat loss for fuel consumption is proportional to the difference in temperature between the inside and the outside, but that the fuel consumption reaches zero when the average inside temperature is 65F, then the average inside temperature during the 24-hour period must be in the neighborhood of 65F.

The commonly assumed figure for the average inside temperature during the hours we are awake is 70F. The temperature that is maintained during the night hours varies rather widely but, as a matter of fact, so does the daytime temperature. At any rate, an average 24-hour inside temperature of 65F could result from the maintaining of 70F inside for 16 hours and 55F for 8 hours.

There are very few data to show just where the nighttime temperature should be maintained. There is sufficient evidence at hand, however, to substantiate the claim that there is a very appreciable saving by setting the thermostat back at night. On the other hand, there is a limit beyond which this is not desirable, due to the fact that it would take too long in the morning to bring the building up to temperature if it were allowed to remain unheated for too long a period during the night. The 55F nighttime temperature assumed above may not be as low as would be desired

[1]Throughout this article only that fuel for the heating of the building itself is considered. The heating of service hot water is not included.

TABLE 1

Day Temperature Inside, F	t_i
70	$\frac{70 \times 16 + 55 \times 8}{24} = 65.00$
69	$\frac{69 \times 16 + 55 \times 8}{24} = 64.33$
68	$\frac{68 \times 16 + 55 \times 8}{24} = 63.67$
67	$\frac{67 \times 16 + 55 \times 8}{24} = 63.00$
66	$\frac{66 \times 16 + 55 \times 8}{24} = 62.33$
65	$\frac{65 \times 16 + 55 \times 8}{24} = 61.67$

TABLE 2

Day Temperature Inside, F	t_i
70	$\frac{70 \times 16 + 55 \times 8}{24} = 65.00$
69	$\frac{69 \times 16 + 54 \times 8}{24} = 64.00$
68	$\frac{68 \times 16 + 53 \times 8}{24} = 63.00$
67	$\frac{67 \times 16 + 52 \times 8}{24} = 62.00$
66	$\frac{66 \times 16 + 51 \times 8}{24} = 61.00$
65	$\frac{65 \times 16 + 50 \times 8}{24} = 60.00$

from a fuel conservation standpoint but, on the other hand, in some installations it may be somewhat too low from the morning comfort viewpoint. There simply are not enough data to show just exactly what this night temperature should be.

Table 1, then, gives the average inside temperature, t_i covering the 24-hour period for daytime temperatures ranging from 65F to 70F but with a constant nighttime temperature of 55F.

Since there is no rule, or no tests to indicate that the thermostat *can't* be set back below 55F, it is of interest to include in our calculations figures for a setback both day and night. Table 2 gives the average inside temperatures, t_i for setbacks of 1F to 5F both day and night.

The two tables, 1 and 2, thus give the essential information on average inside temperatures.

Outside Temperatures

If the average daily temperature for a given year in a typical city in the United States were plotted by days, and with the horizontal scale beginning in midsummer, the graph of these temperatures would look something like that shown in the ragged curve in the accompanying drawing. If the *normal* (or smoothed long-time average) daily mean temperatures for this same city were plotted on the same graph they would plot as a bell-shaped graph as shown in the solid line in the accompanying drawing. In most of the cities in the United States this line crosses the 65F line in the fall and again when rising in the spring.

It was concluded before that a building needs heating when the daily mean temperature is approximately 65F. This is true of buildings where the average maintained temperature is somewhere about 70F and is probably reasonably close within the range where the inside maintained temperature is between 65 and 75F. At least it is close enough throughout to be accurate for most heating and fuel consumption calculations.

This being the case, during an average year heat will be required in the average building when the normal daily mean outside temperature graph falls below the 65F line and will continue to be required until that temperature rises above the 65F line. The dates on which this normal graph crosses the 65F line mark, for an average year, the beginning and end of the heating season. The length of this heating season in days in the accompanying drawing is the distance, d, between these crossings.

Since degree days are a product of time and temperature, the shaded area below the 65F line in the drawing is a graphical representation of the number of degree days during the heating season for a normal year. The number of degree days during the heating season is available for practically all cities, and by the method outlined the number of days during the heating season can be found. With these figures at hand, both the area and the base of the irregularly-shaped shaded area are known. Since this area equals the length of the base times the average altitude, the average altitude t_x can be found by division. By subtracting this t_x from 65 we obtain the average outside temperature, t_a, during the heating season.

These calculations have been made for nearly three hundred cities, and the average heating season temperature for some of them is shown in Table 3.

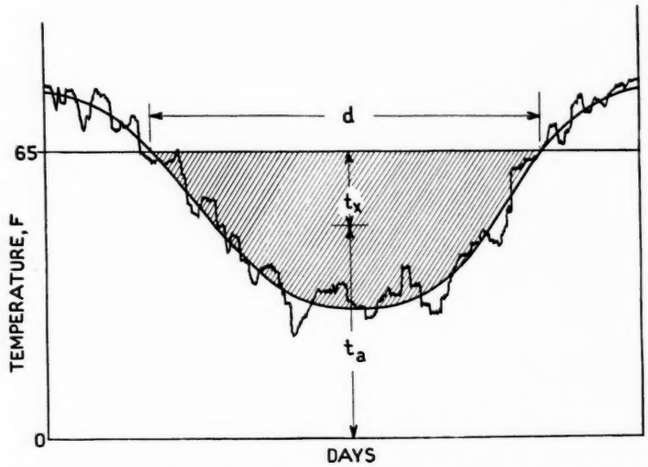


Chart of daily temperatures from August to August in a typical city are shown in the broken line. Normal temperatures are indicated by the solid curve. Shaded area indicates the heating load.

TABLE 3.—AVERAGE OUTSIDE TEMPERATURE DURING HEATING SEASON[2]

City	Average Outside Temp., F, t_a
Boston	42.9
New York	43.6
Pittsburgh	43.6
Baltimore	45.5
Atlanta	50.6
Birmingham	55.2
Buffalo	40.9
New Orleans	57.9
Louisville	46.0
Detroit	40.8
Chicago	40.5
St. Louis	44.3
Denver	43.6
Dallas	52.5
Salt Lake City	44.2
Seattle	51.4
Portland, Ore.	50.3
San Francisco	56.0
Minneapolis	36.4

[2]These figures are from the Degree-Day Handbook (published by The Industrial Press) which includes similar data for 297 cities.

TABLE 4.—FUEL SAVINGS PER DEGREE LOWER TEMPERATURE INSIDE
(For conditions, see text)

City	1F Lower During 16 Day-Hours Only	1F Lower During Whole 24-Hour Period
	%	%
Boston	3.03	4.52
New York	3.13	4.67
Pittsburgh	3.13	4.67
Baltimore	3.44	5.13
Atlanta	4.65	6.94
Birmingham	6.84	10.20
Buffalo	2.78	4.15
New Orleans	9.44	14.08
Louisville	7.44	11.11
Detroit	2.77	4.13
Chicago	2.73	4.08
St. Louis	3.24	4.83
Denver	3.13	4.67
Dallas	5.36	8.00
Salt Lake City	3.22	4.81
Seattle	4.93	7.35
Portland, Ore.	4.56	6.80
San Francisco	7.44	11.11
Minneapolis	2.34	3.50

Temperature Differential

Since information on determining both the average inside and average outside temperatures has now been assembled, the temperature differential $(t_i - t_a)$ can now be computed.

Since the fuel used is proportional to the temperature differential, the fuel used at the standard 70F day (and 55F night) is proportional to the term $[(t_i)_{70} - t_a]$. Similarly, the fuel used at any other lower inside temperature x is proportional to $[(t_i)_x - t_a]$. The saving over the 70F condition can then be expressed by the formula:

$$\% \text{ Saving} = \frac{[(t_i)_{70} - t_a] - [(t_i)_x - t_a]}{[(t_i)_{70} - t_a]}$$

$$\text{or } \% \text{ Saving} = \frac{(65 - t_a) - [(t_i)_x - t_a]}{(65 - t_a)}$$

$$\text{or } \% \text{ Saving} = \frac{65 - (t_i)_x}{65 - t_a}$$

For a 1F temperature drop inside during day hours only, the term $(65 - t_i) = .67$, and for a drop of 1F for the 24-hour period, $65 - t_i = 1.0$. For either of these the saving per 1F is simply

$$\% \text{ Saving} = \frac{.67}{65 - t_a} \text{ or } \frac{1.0}{65 - t_a} \text{ as the case may be.}$$

These savings have been worked out in Table 4.

From this table we see that if we set the thermostat back 1F during the day only in Boston we would expect to save 3.03% of the fuel. A five-degree setback would give 15.2% saving in that city. If we set back the thermostat 1F for the whole 24-hour period in Boston we would save (theoretically at least) 4.52%. In New Orleans, on the other hand, a 1F day setback would save 9.44% and a 1F 24-hour setback 14.08%. A 5F daytime setback in New Orleans would be expected to save 47%.

So far nothing has been said about heat lag. If at 11 p.m. the thermostat is set back to 55F and raised to 70F again at 6 a.m., the inside temperature obviously does not respond at once.

If a plot were made of time as a horizontal coordinate and inside temperature on a vertical scale, the inside temperature to be maintained would plot as a horizontal line dropping vertically at night and rising vertically in the morning. The distance between the drop and the rise would be the number of hours the thermostat is set back, and the rectangle below 70F and above the night temperature would be the theoretical saving. This does not happen, however, in the case of temperatures actually maintained. The temperature drops along a slope whose angle depends on the specific heat of the building, and the heat represented by the triangle is lost and deductible from that theoretically saved. At the time of the morning rise the temperature follows a curve until the building is up to 70F, and the resulting triangle encloses an area representing a quantity of heat presumably not shown to be saved by the theoretical conceptions, but actually saved, and consequently addable to the theoretical saving. The two areas are presumably equal, balance, and thus make no change in the theoretical saving, provided that the night setback is calculated over the number of hours between the time the thermostat goes on night setting and when it goes on day setting. The tabulations here are on the basis of this time being eight hours.

Would these savings actually take place? The answer to this is that it is doubtful if anyone really knows. The theory seems sound enough, however, and to prove that it does not apply would require a careful analysis of records from a large number of buildings, with corrections for fuel used for service hot water and so on —an enormous job that no one has ever attempted.

Until data proving otherwise are made available, it would seem logical to base calculations on this method. As to the results, the figures do show that very small drops in inside temperatures will produce quite worthwhile savings and, conversely, slight overheating would be expected to be very wasteful of fuel. The theory also bears out what is now pretty well conceded—that night setback of thermostats is highly profitable to the building owner.

35-50% VOLUNTARY CUT

in Air Conditioning is proposed by Industry Committee · Essential applications would be continued

An industry-proposed program for a curtailment of between 35% and 50% in the total production of the air conditioning and refrigeration industry, to be accomplished by eliminating non-essential civilian uses, has been submitted to the Office of Production Management by Sub-committee No. 4 of the recently appointed Air Conditioning & Refrigeration Industrial Advisory Committee.

Sub-committee No. 4, concerned with priorities, ratings and allocations, urges OPM to classify civilian air conditioning and refrigeration projects as "essential", "less essential" and "non-essential", and to issue such blanket priority ratings as may be necessary to continue a certain amount of civilian work as a background for defense needs.

It is the contention of the committee that production of defense requirements will be impossible unless provision is made to provide sufficient materials for manufacturers to keep plants and personnel busy on a reasonable amount of civilian items.

The committee's plan is contained in a letter from it to OPM and dated October 22. In this letter, the committee defines air conditioning and refrigeration, points out that it enjoys the confidence of and speaks for 163 companies, large and small, representing practically 100% of the manufacturing capacity of the AC&R industry, and states that the industry at present is doing an average of 39.9% defense work. The letter continues by pointing out that certain important applications of the industry's products are essential and, in fact, the foundation of the Defense Program itself. The sudden and spasmodic orders from the Navy, Army and other governmental agencies require the continued maintenance of the manufacturers' engineering and production staffs, the letter states, and then proposes the following plan:

"Appendix II lists uses of refrigerating and air conditioning equipment for each basic industry of the country. Appendix III explains, in more detail, for just what purpose the equipment is used. Since there are so many different applications of air conditioning and refrigeration (industrial and commercial), there are necessarily many sizes and types of standard equipment produced, as well as special designs to meet particular needs. Because of the varying demand for any one size for essential and non-essential uses, it would be impracticable to curtail production by means of a quota based on sizes or types. It should be relatively easy, however, to decide that certain basic industries which require air conditioning or refrigeration are essential or unessential in the present emergency, and then to determine that the function of air conditioning or refrigeration is either necessary or not necessary for the particular industry. In Appendix II, we have indicated our objective opinion as to the degree of essentiality of each use.

"(a) The Office of Production Management would determine those civilian uses of air conditioning and refrigeration which are "essential", "less essential", and "non-essential". The method of making this determination might be along the lines which we have suggested in Appendix II.

"(b) A blanket rating (A-3 is suggested) that is high enough to permit the obtaining of materials, such as copper and steel, would be assigned to our industry for the "essential" civilian uses.

"(c) A blanket rating of A-3 might also be assigned for the obtaining of materials to anticipate production requirements for "defense uses", limited simply to the minimum inventories needed for production schedules. This would eliminate the requirement of the complicated PD-25 defense supplies rating, which has proved almost impracticable for our industry. The production of equipment for direct defense uses and the production of equipment for essential civilian uses should proceed together, in order that production schedules may be arranged efficiently. The manufacturer should be able to obtain materials to anticipate production requirements for both, under the same supplies rating plan. A manufacturer cannot operate effectively unless he knows how much material he is going to get and when he will be able to get it.

"(d) A lower blanket rating might be assigned to enable the obtaining of more limited quantities of materials for those uses determined as "less essential" civilian uses.

"(e) A preference rating order would be issued for the granting of preference ratings needed to obtain supplies to anticipate production requirements for the filling of orders for the "essential" and "less essential" civilian uses and "defense uses".

"(f) For those uses determined as "non-essential", as suggested in Appendix II, no preference rating would be given.

"(g) Our industry would undertake the responsibility of closely supervising and of policing the uses of such materials, in conformity with the law. Further, it would, by affidavit, guarantee that materials obtained under the respective preference ratings would be applied only to the authorized uses."

As the committee states: "It is estimated that such a program would result in a curtailment of between 35% and 50% in the total production of our industry for civilian uses. Based on the production of our industry for the 12 months ending August 31, 1941, and allowing for increased demands for defense uses, there should be a net reduction of at least 20% in raw materials required. . . .

"We respectfully ask for action. What we need more than anything else is a tangible program which will enable us to keep our skilled personnel together and allow us to produce equipment for essential civilian and defense requirements."

(Continued on Page 72)

McKittrick

Bentley

Faust

Schellenberg

Knight

Pearse

Some of the members of the AC & R Advisory Committee

TYPICAL INDUSTRIES INVOLVED IN DEFENSE OR ESSENTIAL CIVILIAN REQUIREMENTS FOR WHICH REFRIGERATING AND AIR CONDITIONING EQUIPMENT IS NECESSARY FOR THE PURPOSES SHOWN

(This partial list constitutes Appendix III to the AC&R industry sub-committee's letter of October 22 to O.P.M.)

INDUSTRY	PROCESS INVOLVED	ESSENTIAL FOR
Abrasives	Processing and drying of carborundum wheels and paper.	Uniformity of product. Production scheduling.
Airplanes and Engines	Rivet temperature control Engine and parts machining. Propeller processing. Paint and dope application. Assembly.	Controlled precision and uniform tolerances. Elimination of effects of humidity and temperature variations in paint and dope processes, and in laboratories and test rooms.
Ammunitions	Powder and explosives processing. Ballistics, detonators, fuses, ignitor packing, pompom mix. Grinding, priming, pressing, solvent reclaim. Tetryl blending and pressing.	Fixing rate of burning of powder. Accurate weighing. Precision of parts. Static and humidity control. Safety from explosions.
Bakeries	Flour storage. Fermenting. Dough mix. Proofing. Cooling.	Mold prevention. Control of fermentation. Uniform quantity production. Sanitation. Storage.
Cereals, Foodstuffs	Processes too numerous for listing.	Spoilage prevention. Uniform quantity production. Sanitation.
Chemicals	Processes too numerous for listing.	Control of rates and limits of chemical reactions. Quality and purity control.
Dairy Products	Processes too numerous for listing.	Uniform products, sanitation, preservation as otherwise impossible.
Electrical Products	Processing of motors, controls, radio parts, telephone equipment.	Precision, tolerance control, dust prevention, prevention of damage by humidity and perspiration action.
Films	Coating, drying, cutting, and packing.	Uniform pliability, thickness and coating. Scheduled quantity production, and safety from fire.
Food Preservation		Impossible otherwise to prevent spoilage.
Glass	Intermediate steps in processing	Uniform quantity production with controlled schedules. Imperative in making non-shatterable glass.
Hosiery	All stages of processing.	Static prevention, uniform product, and production rate.
Instruments Watches, Navigation and Fire Controls	Tool processing. Parts processing. Gauging.	Precision, condensation prevention, tolerance control, dust elimination, uniform quantity production.
Laboratories	Industrial testing. Animal assay. Growth and sprouting. Crystallization.	Without controlled conditions to eliminate effects of variations, much of this work would be impossible.
Linoleum (Battleship)	Intermediate steps in processing.	Uniform product and schedules.
Machine Shops	Precision rooms.	Close tolerances, constant measurements.
Mines	Mining areas.	Maximum production.
Meats, Lards, etc.	Processes too numerous for listing.	Mould prevention, sanitation, ingredient control, curing time control, uniform quantity production, storage, preparation, etc., as otherwise impossible.
Opticals, Sights, etc.	Lens development. Lens assembly. Cementing. Precision room. Experimental room.	Precision, tolerances, mar prevention, condensation prevention, etc., as otherwise impossible.
Pharmaceuticals	Processes too numerous for listing.	Uniform quantity production of many drugs would be otherwise impossible.
Petroleum Products	Various stages of processing. Testing laboratories.	Uniform quantity production. Octane requirements.
Plastics	Intermediate stages of processing.	Reaction control, uniform production.
Paints and Lacquers	Pigment processing, etc.	Control of air moisture needs, drying rate, etc.
Paper	Processing, testing, storing.	Control of strength, sizing, and moisture content.
Rubber	Drying and curing. Latex processing. Roller cooling.	Process, schedule, and quantity control.
Printing (Maps, etc.)	Processing and storage.	Alignment control, static elimination, uniform sizing, production rate.
Steel	In blast furnaces.	Increased quality and quantity of production of iron with lower coke consumption.
Synthetic Products: Rubber Nylon Rayon Etc.	Processes too numerous for listing.	These products could not otherwise be uniformly produced at all in quantity.
Telephone Exchanges	Apparatus room. Switchboards.	Control of static, prevention of sparking, elimination of corrosives in air.
Textiles	Spinning. Weaving.	Static control, uniform texture and quantity production, otherwise impossible.
Transportation (Perishables)		Long hauls otherwise impossible.

Iceland is famous for its hot springs. Here is a gusher before being connected to the piping which serves Reykjavik, the capital, with hot water for heating its buildings.

Iceland's District Heating System Uses Water from Hot Springs

The present occupation of Iceland by American troops has focused American attention on that island to a greater extent than at any previous time. For that reason a description of the large central heating system, part of which is in use and part still under construction, and connected to hot springs as a source of heat, is of interest.

ICELAND has an area of about 40,000 square miles of which about half is available for cultivation. The principal city and capital is Reykjavik, situated along the southern coast, and with a population of about 30,000. Even prior to the use of water from the hot springs the city's modern buildings were heated by hot water, and this method is very common even with the older buildings.

Climatically the city is affected by two extremes of ocean currents—cold Arctic currents touching on the northern shore and the warmer Gulf Stream impinging on the southern shore. The latter accounts for the rather mild winter temperatures, which average from 48 to 50F on the southern and western coasts.

There are numerous hot springs in Iceland and not too far from Reykjavik there are over a hundred in a small area.

In 1929 the Icelandic Engineering Association considered the matter of heating Reykjavik buildings by hot water from the springs. Funds were appropriated and the first springs were drilled in an area about two miles from the city. The drilling and utilization of this water was reported by Ben Grondal of Reykjavik in an ASHVE paper in 1931. In that paper Mr. Gondal described the original system, which consisted of three motor-driven pumps with a capacity of about 17 gal. per sec. and which pumped the hot water into the town through 7 in. seamless steel pipes connected by welded joints. The pipes were insulated with cork with an 0.8 inch thick cover of concrete cast around it. This in turn was asphalted, wrapped in jute and finally wrapped in feltpaper. At intervals of 165 ft expansion joints were used. At the town end of the piping a pressure regulator was installed to control the operation of the electric pumps to maintain a uniform pressure in the supply line.

Mr. Grondal's paper indicated that the system was intended for the heating of three buildings then in the course of construction—the National Hospital, a school, and an enclosed swimming pool. The school alone had a maximum heat loss of over 3,000,000 Btu per hour.

The temperature of the water leaving the spring when the installation was completed was about 183F and about 178F when it arrived at the school building, 8850 ft from the spring.

In general the plan was to circulate the hot water through the radiators following which the water is used to heat the swimming pool or for laundry purposes before being discharged to the sewer.

The system reported by Mr. Grondal ten years ago has been in continuous operation ever since and at the present time, in addition to the hospital, the school and the swimming pool, is supplying a swimming hall, another school, and 72 houses.

Since the original installation the flow of water in the system was increased about 50% by making deeper borings. In addition the average temperature of the water supply rose about 9F. Consequently, following an estimate by the town engineers, final plans were made for a much larger system by a Danish engi-

neering firm which raised the necessary funds for the enterprise and began construction of a new system in 1939. This work, which has been going on continuously ever since, was to have been completed by the end of 1940 but the war caused a number of delays and the system is not yet finished.

In order to get sufficient water for the larger system it was necessary to go a greater distance from the town in the direction of the concentrated hot spring area. Thermal springs 10 miles from the town are now linked up, the hottest of which gives water at 178F. The new wells drilled during and since 1933 are all of 4 in. in diameter except four which are 6 and 8 in. in diameter. These reach a depth from 446 to 2050 ft, with an average depth of 1040 ft. The borings have been made over an area of about .3 x .6 miles. All the holes but one have yielded water, the hottest producing 360 gpm at a temperature of 208F. The hole with the best yield gives 576 gpm at a temperature of 189F. The total volume of water of the present system is now just over 3744 gpm at a temperature of 189F. According to *The Heating and Ventilating Engineer & Journal of Air Conditioning* (Gr. Br.), in the new hot water supply system the hot water runs by gravity from the borings and springs into a common reservoir. From there it is pumped by electric centrifugal pumps through two pipes, 13 in. in diameter, up to a hot-water reservoir standing on a hill just outside the town. Each of these pipes is 9.5 miles long. The collecting pipes, the pumps and the two main pipes are constructed for a flow of 4680 gpm. As a start, five tanks each of 1000 tons capacity will be built, but later it is proposed to increase this number to eight. The tanks will be of reinforced concrete.

From the tanks, two 16-in. pipes lead down into the town; pipes then branch off into each street, and pipes enter each building in the town from the street mains. The diameter of street mains varies from 1 in. to 18 in., their total length being over 25 miles. The whole piping system, excluding the building piping, totals about 46 miles in length, with the town system calculated for 7800 gpm. There will also be a pumping station near the tanks, this being intended to increase the pressure of water in the town when most needed.

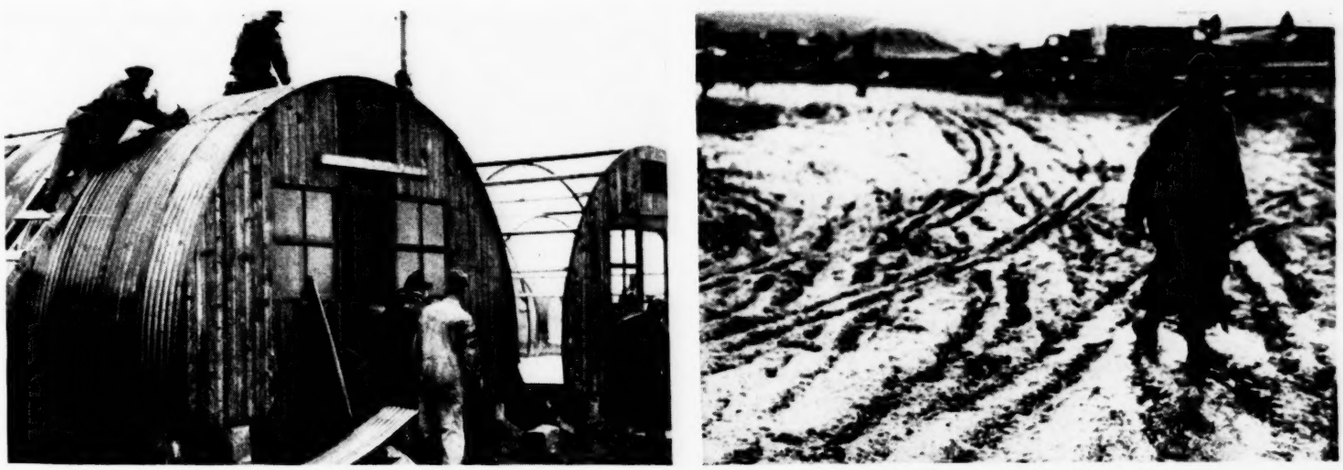
According to our British contemporary, all the mains are insulated with materials of Icelandic origin, chopped turf and pumice, but outside the insulating layer cement is used for protection. The double feed pipe lies in a single cement trough, mainly above ground, but the street mains are dug down into the pavements. On the other hand, the house leads will be mostly insulated with glass wool, and round that will be a protecting layer of bitumen.

Typical Icelandic houses. Note that most of them are well built. Even before the district hot water heating system was installed in Reykjavik the majority of the houses were heated by individual central hot water systems.

The temperature drop of the water between the springs and the last building on the line is estimated at 9F when the consumption of heat is greatest. As in the present hot-water system, the water in the new system will be pumped straight into the heating system of the buildings, and the warm water leaving the heating pipes will be used for baths, laundry, heating garden beds, and so on. There is little need of expense for changes in the houses themselves, as 80% of all the houses in the town already have central-heating systems.

The new system is intended to heat the whole town except the sparsely built suburbs. Altogether about 3000 houses will be heated.

Based on a water supply at 189F, with a 9F drop in the piping, and with 105F leaving water temperature, the average cooling range will be approximately 75F. Thus, with a flow of 3744 gpm the capacity of the system will be somewhere in the neighborhood of 140,500,000 Btu per hr.



(Left) U.S. Marines, British Tommies and U.S. Infantrymen building their new homes in Iceland. (Right) A U.S. officer in Iceland encounters another familiar officer—General Mud.

Stoker Markets Indicated in Survey by Stoker Manufacturers' Association

AS of August 1, 1941, there were 668,823 bituminous coal burning stokers and 96,669 anthracite burning stokers operating in the U. S., a total of 758,492. Forty-four per cent of these were in the five states of Ohio, Illinois, Michigan, Indiana and Wisconsin, although Pennsylvania, New York and Missouri ranked high.

These figures are from a report of the Stoker Manufacturers' Association, made in cooperation with and at the specific request of Government defense officials, one of a number of reports on stoker manufacturing and marketing problems under emergency and defense conditions.

"In preparing these reports for Government agencies," Frank Hoke, president of the Association and chairman of the stoker industry's national defense committee said, "the thought governing the presentations is to show the benefits in many ways accruing to the nation at large from the use of automatic coal burning equipment utilizing the nation's most economical and abundant fuels."

Mr. Hoke stated that an effort to show the widespread use of mechanical coal burning devices resulted in a decision to make a very careful survey to show for the first time authoritative and accurate statistics on the installation of stokers by regions and states. Through the cooperation of manufacturers representing over 90% of the total unit volume of the industry for installations made during the past fifteen years, the Association has made public the figures appearing in the accompanying table.

In addition to pointing out that Illinois and Michigan lead in stoker installations, the statistics show a high percentage of installations in the Far Western and Pacific Regions, where 72,760 stokers are installed, 9½% of the country's total installations. This is a high percentage, considering the low density of population in that area.

Of the total number of stokers installed, anthracite machines in the New England and Eastern states total 96,669, or 12¾% of the total. Bituminous installations total 661,823, or 87¼% of the country's total installations. Included in these figures are a small number of installations in Alaska.

The compilation does not include central station or the largest industrial stokers, nor does it take into account replacements, removals or re-possessions, but these will easily be compensated for by the installations of a number of smaller companies which did not report and by the installations of the power and large industrial units. Sales of stokers shipped outside the United States are not included.

GEOGRAPHICAL DISTRIBUTION OF STOKERS, AS OF AUGUST 1, 1941

(Figures do not include central station or large industrial plants)

State and Region	Number of Stokers Operating			Per Cent of Total
	Anthracite	Bituminous	Total	
Maine	1,719	1,425	3,144	.41
New Hampshire	1,547	504	2,051	.27
Vermont	1,941	294	2,235	.30
Massachusetts	12,039	5,863	17,902	2.36
Rhode Island	1,358	383	1,741	.23
Connecticut	3,051	611	3,662	.48
New England Total	21,655	9,080	30,735	4.05
New York	25,146	13,021	38,167	5.03
Pennsylvania	34,737	16,559	51,296	6.76
New Jersey	8,023	2,566	10,589	1.40
Middle Atlantic Total	67,906	32,146	100,052	13.19
Maryland	2,663	3,136	5,799	.76
Delaware	469	173	642	.09
District of Columbia	3,976	1,825	5,801	.76
West Virginia	—	5,729	5,729	.76
Southeastern Total	7,108	10,863	17,971	2.37
Virginia	—	—	13,368	1.76
North Carolina	—	—	15,896	2.10
South Carolina	—	—	4,202	.56
Georgia	—	—	10,161	1.34
Alabama	—	—	7,806	1.03
Mississippi	—	—	521	.07
Florida	—	—	119	.02
Louisiana	—	—	139	.02
Arkansas	—	—	638	.08
Tennessee	—	—	22,998	3.03
Kentucky	—	—	15,403	2.03
Southern States Total	—	—	91,251	12.04

State and Region	No. of Stokers Operating	Per Cent of Total
Ohio	49,610	6.54
Michigan	83,913	11.06
Indiana	41,661	5.49
Illinois	116,767	15.40
Wisconsin	42,700	5.63
East Central Total	334,651	44.12
Minnesota	25,578	3.37
Missouri	42,697	5.63
Iowa	22,869	3.01
Kansas	3,693	.49
Nebraska	10,253	1.35
North Dakota	2,776	.37
South Dakota	3,206	.42
West Central Total	111,072	14.64
Colorado	18,796	2.48
Wyoming	1,801	.24
Utah	25,164	3.32
Idaho	10,061	1.33
Montana	3,550	.47
Washington	9,223	1.21
Oregon	1,863	.24
California	220	.03
Nevada	647	.08
Arizona, Oklahoma, New Mexico and Texas	1,061	.14
Alaska	374	.05
Western and Pacific Total	72,760	9.59

Testing the Short Cut Method of Calculating Radiation

By FRED CARNES

The author summarizes the basic short cut formula and corrections developed in a previous article, solves typical examples, and compares the results with those from other methods. This article is complete in itself and no reference need be made to the previous article unless you question the validity of his formula.

NOW that the formula and its corrections have been developed, let us summarize them. Then if you wish to figure radiation and get the same results as by the long crack method, all you have to do is to follow the steps given here.

Basic Formula—For ordinary uninsulated houses (U = 0.25) with average windows, a temperature difference of 80F, and a wind velocity of 10 miles per hour, *the basic formula* for steam radiation is

$$R = \frac{W_g + 3G + \frac{1}{2}wl}{10}$$

where W_g is the *gross* exposed wall area, G the area of windows and doors, w the width of the room, and l the length.

As has been shown, this formula is practically exact where the number of windows in the room is $W_g/60$ and where not more than half the number of windows are on one wall of the room.

Ceiling Correction for ordinary houses with insulated upstairs ceilings (U = .20 or less), the formula becomes

(a) for top floor rooms $R = \frac{W_g + 3G}{10}$

(b) for downstairs rooms use the basic formula.

For bungalows with ordinary *uninsulated* ceilings, the formula becomes:[9]

$$R = \frac{W_g + 3G + wl}{10}$$

For bungalows with *insulated* ceilings the formula is:

$$R = \frac{W_g + 3G + \frac{1}{4}wl}{10}$$

For multi-flat or similar buildings where air cannot rise from downstairs to upstairs rooms, with ordinary uninsulated ceilings, the formula becomes

(a) for top floor rooms $\frac{W_g + 3G + wl}{10}$,

(b) for middle floor rooms $\frac{W_g + 3G}{10}$,

(c) for bottom floor[10] rooms $\frac{W_g + 3G + 1/10wl}{10}$

For multi-flat, office or similar buildings with insulated top ceiling, the formula becomes

(a) for top floor rooms $\frac{W_g + 3G + \frac{1}{4}wl}{10}$,

(b) for middle floor rooms $\frac{W_g + 3G}{10}$,

(c) for bottom floor[11] rooms $\frac{W_g + 3G + 1/10wl}{10}$

Window Corrections. First, divide W_g by 60 to get the "normal" number of windows, for which the formula is exact as regards heat transmission. Add 1 sq ft of steam radiation for each outside window (and door) above the "normal" number. Subtract 1 sq ft for each window below the normal number. This correction is unnecessary if a correction for a wall coefficient other than .25 is made. Second, divide the number of windows by two to find the number used for crack in the formula. If any one wall of the room has more windows than this number, add two square feet of steam radiation for each window over it. For example, if a room has three windows, two on one wall and one on another, then $3 \div 2$; $2 - 1\frac{1}{2} = \frac{1}{2}$; therefore add 1 sq ft of radiation to formula result to take care of crack for the half window. Third, no corrections are to be made for weatherstrips and storm sashes.

Wind Velocity Correction. If you wish to use some other wind velocity than 10 miles per hour: for 16 miles per hour add $\frac{G}{10}$ to the formula result, for 13 miles per hour add $\frac{\frac{1}{2}G}{10}$, etc. For example, if a room has 30 sq ft of glass, add 3 sq ft for 16 miles per hour; $1\frac{1}{2}$ sq ft for 13 miles per hour; 1 sq ft for 12 miles per hour, and so on.

Corrections for Wall. If the coefficient for the wall is other than .25, put the formula in the form[10]

[9] The term ¼ wl is for insulated ceilings (rock wool between joists) with U = .08. If 1 in. rigid insulation is applied (U = .20) use ½ wl.

[10] Use wl, ½ wl, ¼ wl, or 1/10 wl as the case may be, as described before.

[11] Where steam pipes to upstairs radiators are inside bottom floor rooms or where it is known that it is warmer in the basement below the room floor than in the room at the floor this 1/10wl is unnecessary and may be omitted.

$$\frac{W_n + 4G + \frac{1}{2}wl}{10},$$

where W_n is the *net* exposed wall area. Add to the term 4G, 1/6 of it. Consider W_n as being correct for $U_{wall} = .30$ and proportion it according to your desired wall coefficient. For example, suppose W_n is 200 and G is 36, and you wish to use $U_{wall} = 0.27$. Now .27 is .30 less 1/10 of .30, so subtract 1/10 of 200 from 200 and get 180; add 1/6 of 144 to 144 and get 168; total, 348. Taking the 10 in the formula into account, the correct radiation (excluding ceiling) is therefore 34.8 instead of the 34.4 as given by the original formula. At the same time the necessity for the first window correction is eliminated since adding 1/6 to 4G takes care of it.

Temperature Correction. For temperature difference other than 80F, add 1/7 to the formula result for 90F; for 70F, subtract 1/8. For 88F, add 10% and so on.

Wind, Exposure, Other Corrections. Here you can only use your own judgment. 15% is suggested by handbooks for exposure.

Typical Examples

To show how our formula is applied let us work out a few examples.

Example 1: Corner room 16 × 14 × 8 ft, with two 12 sq ft windows on each wall. Temperature difference 80F. Ordinary walls, $U_w = .25$. Gross wall is 240 sq ft.; glass area, 48 sq ft; net wall 192 sq ft; crack length used (2 windows) = 2 × 17 = 34 ft.; volume of air leakage per foot of crack for 10 miles per hour, 21.4 cu ft per hr. *Neglecting the ceiling* for the present (see Example 5) the exact steam radiation required *by the standard method* is:

$$\frac{192 \times .25 \times 80}{240} + \frac{48 \times 1.13 \times 80}{240} + \frac{34 \times 21.4 \times .018 \times 80}{240} = 38.5 \text{ sq ft.}$$

By the short cut formula the radiation, neglecting ceiling, is

$$R = \frac{W_g + 3G}{10} = \frac{240 + 144}{10} = \frac{384}{10} = 38.4 \text{ sq ft.}$$

Since $W_g \div 60$ or $240 \div 60 = 4$ is the same as the actual number of windows no correction is required for windows above or below the "normal." Also since the number of windows used for crack is exactly one half the total number of windows no correction is required here either.

Example 2: Room 16 × 14 × 8 ft with the 16 ft side exposed and with three windows each 10 sq ft. Temperature difference 80F. Ordinary walls, $U_w = .25$. Gross wall is 128, glass is 30, and net wall 98 sq ft. Crack length used 3 × 15.5 = 46.5 ft.

Neglecting ceiling, radiation by standard method is

$$\frac{98 \times .25 \times 80}{240} + \frac{30 \times 1.13 \times 80}{240} + \frac{46.5 \times .018 \times 21.4 \times 80}{240} = 25.4 \text{ sq ft}$$

Radiation by our basic formula, neglecting ceiling, is

$$R = \frac{W_g + 3G}{10} = \frac{128 + 90}{10} = 21.8 \text{ sq ft}$$

First correct for windows. Since $\frac{128}{60} = 2$, approx., and since we have three windows, therefore must add 1 sq ft. Second, the number of windows which should be used in this case for crack is 3, while the basic formula provides for 3 ÷ 2 = 1½. Since 3 — 1½ = 1½, we are shy of crack for 1½ windows. As mentioned allow 2 sq ft for each window, so that 1½ × 2 = 3 sq ft. Therefore, we should add 1 sq ft for transmission and 3 sq ft for crack, or 4 sq ft, making our total 21.8 + 4.0 or 25.8, as compared with the exact 25.4 sq ft.

Example 3: Room 16 × 14 × 8 ft with three sides exposed, 1 long, 2 short. Five 15 sq ft windows, three in the long side and one in each of the short sides. Temperature difference, 80F; ordinary walls, U = .25. Gross wall 353, glass 75, and net wall, 277 sq ft. Crack length, 3 × 19 = 57 ft.

Neglecting ceilings, exact radiation is 58.4 sq ft. By our formula it is

$$R = \frac{W_g + 3G}{10} = \frac{352 + 225}{10} = 57.7 \text{ sq ft}$$

First correction: Actual number of windows....5
Normal number, 352 ÷ 60....6
Sq ft radiation to be added —1

Second correction: Number of windows that ought to be used for crack.....3
Number of windows actually used, 5 ÷ 2 = ...2½
Number of windows shy..... ½

Now ½ × 2 = 1 sq ft. Therefore our corrections —1 and +1 balance, making our corrected figure the same as before, 57.7 or 58 sq ft compared with the exact figure 58.4.

Example 4: Same room as Example 3 except that $U_{wall} = .15$ instead of .25.

Neglecting ceilings, the exact radiation is 49.2 sq ft. By our formula

$$R = \frac{W_g + 3G}{10} = \frac{W_n + 4G}{10}$$

$$10R = W_g + 3G = W_n + 4G$$

$$10R = 277 + 300$$

Since .15 (U) is ½ of .30 and since 277 or W_n is the correct wall radiation to figure for $U_w = .30$ we simply divide 277 by 2 to get the figure for U = .15. This gives 139. Then add 1/6 of G or 1/6 of 300 to 300 and get 350. Then 139 + 350 = 10R = 489, so that R = 48.9 sq ft.

Any other value of U can be handled the same way; for example, for U = .10, divide by 3, for U = .20 subtract 1/3, etc. Also, since 4G, we found, was 14½% too low, we add 1/6 to the 300.

The correction for windows above the "normal" is not used here as adding 1/6 to 4G takes care of it. The extra crack length as given in Example 3 should be used, however, so that we should add 1 sq ft, getting a total of 49.9 sq ft as compared with the exact 49.2 sq ft.

Example 5: Ceiling calculations for rooms in examples 1 to 4:

First, top floor ceilings. Ordinary lath and plaster, uninsulated. If these rooms are in an ordinary house, where warm air can rise from downstairs to upstairs it is necessary, we found, to add $\frac{\frac{1}{2}wl}{10}$ to the wall, window and leakage figures for both upstairs and downstairs rooms.

Since $\frac{\frac{1}{2}wl}{10}$ for all these rooms is 11.2, our totals, including ceilings, become:

Example 1. 38.4 + 11.2 = 49.6 sq ft
Example 2. 25.8 + 11.2 = 37.0 sq ft
Example 3. 57.7 + 11.2 = 68.9 sq ft
Example 4. 48.9 + 11.2 = 60.1 sq ft

If the rooms are in a bungalow, or on the top floor of multi-flat or office or apartment buildings, where no warm air can rise from downstairs, we should add $\frac{wl}{10}$ or 22.4, making our results:

Example 1. 38.4 + 22.4 = 60.8 sq ft
Example 2. 25.8 + 22.4 = 48.2 sq ft
Example 3. 57.7 + 22.4 = 80.1 sq ft
Example 4. 48.9 + 22.4 = 71.3 sq ft

If the rooms are on lower or middle floors of multi-flat buildings with warm rooms over them, it is not necessary to add anything for ceilings. If greater accuracy is desired, however, it is advisable to add $\frac{wl}{100}$ or 2.2 sq ft to take care of the difference between the ceilings of lower rooms and the floors of warm rooms above. Middle floor rooms do not need this correction since any heat lost through the ceiling to rooms above is made up by heat gain through the floor from rooms below. The results for lower floor rooms become:

Example 1. 38.4 + 2.2 = 40.6 sq ft
Example 2. 25.8 + 2.2 = 28.0 sq ft
Example 3. 27.7 + 2.2 = 59.9 sq ft
Example 4. 48.9 + 2.2 = 51.1 sq ft

Assume now that the top floor ceilings are insulated with rock wool, with a U of .08:

In an ordinary house for downstairs rooms the same addition should be made as for uninsulated ceilings, namely, 11.2 sq ft since there is nothing to prevent the air rising to upstairs. For top floor rooms, since U is below .20 no addition for ceilings is necessary to the figures of Examples 1 to 4; that is, they will still be 38.4, 25.8, 57.7, and 48.9 sq ft, respectively.

If the rooms are in a bungalow, or on the top floor of multi-flat or office buildings, the whole ceiling should be considered. We found that the temperature difference between room and attic will be about 72F instead of 40F, with a ceiling U of .08. Therefore, we should add to the results of Examples 1 to 4 $\frac{\frac{1}{4}wl}{10}$ or 5.6 sq ft making the results 44.0, 31.4, 63.3 and 54.5 sq ft, respectively.

If the rooms are on the lower or middle floors of multi-flat and similar buildings where warm air can not rise to the upstairs and where there are warm rooms over them, it of course makes no difference to them whether the ceilings of the top floor rooms are insulated or not. For such rooms therefore the radiation will be the same as in Examples 1 to 4, unless you wish to allow for the heat being transferred through the ceilings of lower floor rooms to the rooms above. In this case 2.2 sq ft should be added the same as where ceilings are not insulated.

Remarks on Examples

It is to be noted that results have been worked out here to .1 sq ft of radiation. It is doubtful whether such closeness is necessary or even desirable. For you are certainly more likely to make arithmetical mistakes that way once in a while than if you stick to even figures.

I wonder how long it takes the average person to figure the radiation for a room after he has computed the gross wall area and the window area. To do so by the formula

$$R = \frac{W_g + 3G + \frac{1}{2}wl}{10}$$

takes, where you use even feet, about half a minute. The two corrections, if you wish to use them, take a little longer, because you have to stop and think whether to add or subtract. The actual corrections take only a few seconds but you have to take enough time to be sure you make them the right way.

As to whether it is necessary to make the two corrections, it is only if you wish to get the same results as by the standard crack method. If you are satisfied to be somewhere between that method and the old-fashioned air change method you do not need to make them. This can be shown by working out Examples 1 to 3 by the air change method, using 1½ air changes for Example 1, 1 for Example 2 and 2 for Example 3. If we tabulate the figures, considering all three rooms as in an ordinary house, we get:

	No. 1	No. 2	No. 3
Radiation by crack method	50	37	70
Radiation by air change method	50	30	73
Radiation by our basic formula, uncorrected	50	33	69
Radiation by formula, corrected	50	37	69

Any one who has followed the derivation of our formula, if there is such a person, can see that these results are about what we should expect. In all three rooms the corrected formula gives substantially the same results as the standard crack method; it was designed to do so. In Example 1, with 1½ air changes, of which one air change takes care of the ceiling, the extra ½ air change takes care of the air leakage. In Example 2, with only one air change, there is nothing left for air leakage so that we should expect the air change method to give less than the crack method; and since our uncorrected formula is based on the crack of half the windows, where, by the rules, in this room, all the windows should be used, we can expect our uncorrected formula results to be less than the crack method and more than the air change method. In Example 3, with two air changes, one of them takes care of the ceiling and one gives an excess over what is required for leakage. If the number of windows were made very large, two air changes would not give enough to do this.

In general it can be stated that (1) our uncorrected formula gives about the same results as using 1½ air changes; (2) in rooms with one exposed wall it gives results greater than one air change but less than the crack method; (3) in ordinary rooms with two exposed walls, all three methods give somewhere near the same results, except that where all the windows are on one wall the crack method results are higher; (4) in ordinary rooms with three exposures two air changes give results higher than the other two; (5) in rooms with an abnormally large number of windows the crack method gives the highest results; (6) the two corrections make our formula agree with the crack method for all shapes and sizes of rooms; (7) if you are satisfied that the old-fashioned method of using one air change gives you enough radiation for rooms with one exposed wall, the only condition where the uncorrected formula will not give the same as, or slightly more than, either the crack or volume method is in rooms with three exposures with a large number of windows, if you use two air changes. Otherwise no corrections need be made.

While only four examples have been given here of how our formula works, I have tried it out on over 200 rooms of various shapes, sizes, exposures and window arrangements. With the two corrections it works on all of them; without the corrections, on most of them, being, however, always within about 5% of the crack method.

Revision of Standard Method

It is easily possible for two people figuring radiation for a room or building and using the methods and data given in standard handbooks, to get results differing as much as 50%. The reason is that so much is left to individual judgment. Consider the living room of the sample house worked out in a standard text book:

The heat loss is figured as 10,180 Btu or 42½ sq ft of steam radiation, of which 37.8 sq ft is transmission loss and 4.7 sq ft infiltration. If, as recommended, you use the air change method as a check, 1½ air changes call for 22.4 sq ft instead of 4.7 sq ft or a total radiation of 60.2 sq ft. If this room faced the prevailing winds and you allow in addition an exposure factor of 15%, the required radiation will be 69 sq ft instead of 42½ sq ft or 63% more. This can hardly be called close figuring, and brings up the following questions:

1. Is the "check" method of any use if it gives results so much at variance with the "more exact" method? Is it not about the same as if when you wanted a suit of clothes, your brother went to the tailor to be measured for it?

2. If the capable and experienced heating engineers who compile handbooks and adopt heat loss calculation methods do not know whether or not it is advisable to add an exposure factor, how can the ordinary heating contractor in the field be expected to know?

3. If radiation were installed in a sample house in accordance with the heat losses as worked out in the standard handbook for the various rooms, would the house heat properly? I doubt if that was the intention although nothing is said about it one way or another. For no account is taken of the heat carried by currents of warm air rising from the downstairs rooms to the upstairs. The fact that this occurs is known to any experienced heating man and can easily be demonstrated by holding a lighted match at the top and bottom of an open doorway leading from, say, a living room into an open hall. Neither is any account taken, in the example, of heat transmitted through ceilings of downstairs rooms, where the air is warm, up through the floors of upstairs rooms where the air is cooler. The old-fashioned volume method took care of both these items. It is evident, therefore, that, while the example gives the heat loss from each room from inside to outside, it does not show, and was probably never meant to, how radiation should be distributed to make the house heat evenly.

It seems plain that if any consistency in results is to be expected, the methods given in handbooks must be made more explicit. At least some recommendations could be made, particularly as regards exposure to prevailing winds and internal air currents. Possibly, for the latter, the suggestion given here, of using half the ceiling for both upstairs and downstairs rooms in ordinary houses, is the simplest way.

It is evident that whoever is responsible for the discussions on air leakage and heating load in handbooks does not take into account that the ordinary heating man either has no judgment or does not want to use it if he has any. All that can be expected of him is to follow definite rules and recommendations; and so far as consistency of results goes, these are what the standard method does not give.

To be of pactical use to the heating industry, therefore, I believe that the present standard method of figuring heat loss should be revised, at least to the extent of settling the three questions of exposure to prevailing winds, transmission from warm ceilings to cold floors, and the air currents prevailing in ordinary houses.

This concludes the author's three part series on calculating radiation.

WASHINGTON NEWS

Heating committee formed · Cut in Air Conditioning proposed · Use of copper restricted · Housing plan

By LORING F. OVERMAN

Washington has undergone a transition in the last 30 days—its thinking is changing from defense production to war production—with a resultant further subordination of civilian interests and a consequent stress upon armament schedules. Among October developments are these:

Formation of the Plumbing and Heating Defense Industry Advisory Committee announced by OPM October 27;

A voluntary cut of 35% to 50% in total production of air conditioning and refrigeration industry proposed by sub-committee of Air Conditioning and Refrigeration Industry Committee on October 22. (See page 46, this issue);

Issuance of allocation order M-9-c governing allocation of copper and brass on October 21. (See page 65);

Order (October 9) curtailing all civilian building projects except those essential to public health and safety;

Repair and maintenance preference rating order P-22, amended to include additional classifications;

Termination of oil curtailment order on October 24. (See page 61, News of the Month, this issue);

Simplification studies announced on October 24 for cold storage specifications and plumbing and heating codes;

First industry-wide certification (household washer and ironer industry) points way to similar plan for defense contract awards in the heating and ventilating industry—October 21.

Heating Committee

Close upon the heels of the appointment of Leighton H. Peebles as chief of the Plumbing and Heating Branch, Division of Civilian Supply, formation of a Plumbing and Heating Defense Industry Advisory Committee was announced by the Bureau of Clearance of Defense Industry Advisory Committees, Office of Production Management.

Committee members are: George Hoffman, manager, Plumbing Division Crane Co., Chicago; William M. Byrd, vice-president, Alabama Pipe Co., Anniston, Ala.; E. S. White, president, U. S. Radiator Corp., Detroit; W. L. McGrath, vice-president, Williamson Heater Co., Cincinnati; E. C. Sammons, vice-president, Iron Fireman Co., Portland, Ore.; J. A. Doucett, vice-president, Revere Copper & Brass, Inc., New York; R. L. O'Brien, president, Detroit Brass and Malleable Co., Detroit; O. L. Swats, assistant sales manager, Grinnell Co., Inc., Providence; M. W. Dennison, trustee, Braman Dow & Co., Boston; L. F. Hudepohl, president, T. S. Conner, Inc., Cincinnati; H. M. Reed, president, American Radiator and Standard Sanitary Corp., New York; Charles D. Wessells, president, D. D. Wessells & Sons Co., Detroit; M. F. May, vice-president, Young Radiator Co., Racine, Wis.; Frank C. Packer, assistant to president, Payne Furnace & Supply Co., Beverly Hills, Calif.; Harold Sweatt, president, Minneapolis-Honeywell Regulator Co., Minneapolis; N. H. Wiewel, assistant general sales manager, Jones & Laughlin Steel Co., Pittsburgh; R. L. Stewart, vice-president, Stockham Pipe & Fittings Co., Birmingham; G. E. Mumma, assistant supervisor, Plumbing and Heating Division Sears Roebuck & Co., Chicago; and Edward Costello, Costello Engineering Co., Washington.

This committee, unofficially the steering committee for the plumbing and heating industry, scheduled its first meeting with Mr. Peebles November 6, at which time sub-committees were to be named and groundwork laid to coordinate the plumbing and heating industry's plans for defense and civilian production. To facilitate the formation and operation of the sub-committees, the following acting chiefs have been appointed from the DCS staff by Mr. Peebles:

Joseph B. Kelly, Jr., Wholesalers, Retailers and Contractors section; J. B. Hungate, Pipes, Valves, and Fittings; Lawrence Knappen, Fixtures and Specialities; David H. Butler, Heating Equipment; and John F. Steele, Program and Priorities.

Beating the gun by two weeks, an Oil Burner and Stoker Sub-committee has already been appointed. Members are E. C. Sammons, vice-president, Iron Fireman Co., Portland, Ore.; J. P. Rainbault, manager, air conditioning and commercial refrigeration department, General Electric Co., Bloomfield, N. J.; J. H. Simpson, vice-president, Hershey Machine and Foundry Co., Manheim, Pa.; Ross Sherman, president, Silent Glow Burner Corporation, Hartford, Conn., and L. A. Welsh, president, Hart Oil Burner Co., Peoria, Ill.

"In selecting the industry committee and the sub-committees from nominations made by industry, every effort is being made to have the personnel represent a balanced cross section of the industry," said Mr. Peebles. "As will be seen in the lists of names announced, the committee members represent large and small manufacturers, widely scattered areas, and both association members and independents.

"The general purpose of the committee and its sub-committees will be to tie the plumbing and heating industry into the defense picture in every way possible. The first premise is that defense production is paramount and that the industry must take immediate steps to participate with the least possible dislocation.

"Undoubtedly the hot topic at the initial meeting will be the Copper and Brass allocation order. Representatives of the industry will doubtless be asked to present information pertaining to minimum requirements, possible substitutes and proposals for adjustments to meet existing conditions.

"Another subject scheduled for discussion is the proposed simplification

Hoffman Sweatt White Reed May Sammons

Some of the members of The Plumbing and Heating Advisory Committee

of building codes to permit greater latitude in defense building installations. Such a revised code is now in the hands of the Plumbing and Heating Branch of the Division of Civilian Supply, and favorable action by defense building authorities is anticipated.

"Those of us charged with the administration of the new defense program are appreciative of the support already given by the plumbing and heating industry. Members of the staff of the new branch will strive to merit continued cooperation as we assume the difficult task of coordinating a great industry to tasks new and strange, but nonetheless essential under present emergency conditions."

Proposes A.C. Cut

A pattern, perhaps, for the new plumbing and heating committee's activities, lies in the proposal of the Air Conditioning and Refrigeration Industry Committee's proposal to cut production 35% to 50% by eliminating non-essential civilian uses.

Submitting a list of scores of present civilian uses of air conditioning and refrigeration, the committee gives OPM in its letter of October 22 three suggested classifications — essential, less essential, and non-essential. (The committee's proposal is more completely discussed in an article on page 46 in this issue.)

Copper Restrictions

While no reports are yet available, there are indications that AC&R committees are making studied efforts seeking relief from the recent priority order governing the allocation of copper and brass—the strictest order yet issued by OPM. The effect of the order on the industry is indicated by the AC&R Industry Committee survey, which reports the use of 42,567 tons of copper and copper alloys, and 14,153 tons of brass during the 12 months ending August 31, 1941.

(The OPM order on copper is further discussed on page 65 of the News of the Month columns in this issue.)

Five days after OPM's issuance of the Copper Allocation Order, Leon Henderson, administrator of OPA, followed with a program to stabilize prices of all products made of copper, brass or other copper base alloys. In announcing the program Mr. Henderson pointed out that curtailment of raw material supplies is not alone sufficient justification for raising the price of any manufactured article. Plans of OPA in regard to products made largely of copper are based on this premise and it will be followed rigidly, he said. Immediate steps in the new program:

(1) A price schedule establishing present prices as a maximum for building hardware will be issued shortly, preparatory to detailed studies looking to a reduction of such prices substantially below present levels. This will be followed by schedules establishing ceilings for other building products made of copper as they may be necessary.

(2) Field investigations under way for some time on the prices of nonferrous foundry products will be rushed to completion with a view to issuing a price schedule establishing maximum prices for such products unless the industry voluntarily agrees to reduce prices. One conference has already been held with a branch of the industry. Products in this category include valves, fittings and other copper or copper allow castings.

(3) Prices for products fabricated from brass will be brought under ceiling as rapidly as necessary.

(4) Attention of the office will also be directed at prices of all durable goods and their parts made largely of copper. Ceilings will be placed on such products if necessary.

In announcing the price stabilization, Director Henderson warned manufacturers and distributors to beware of building up inventories in anticipation of future orders, since they may find themselves trapped with materials bought at high prices when ceilings are issued.

A "minimum practical working inventory shall in no event be more than the amount necessary to maintain operations for 60 days," says the OPM Copper Allocations order.

Housing

To administer the SPAB order issued October 9, under which priorities assistance will be withheld from private or public building projects unless they are necessary to defense or essential to public health or safety, OPM has delegated Leon Henderson's Division of Civilian Supply. Following the assignment of this task to DCS on October 23, a new division to be known as the Construction Branch was set up, with John L. Haynes in charge. The new branch absorbs the Lumber and Building materials branch, of which Mr. Haynes was chief.

Total construction, during 1941, is expected to reach $11,000,000,000, excluding some $3,000,000,000 for maintenance, repair and remodeling. Of the $11 billion, about $5 billion is being spent on defense construction, as follows:

Military	$1,800,000,000
Industrial facilities	1,700,000,000
Defense housing	1,200,000,000
Defense highways	200,000,000

Non-defense construction for the year totals as follows:

Residential	$1,800,000,000
Industrial	500,000,000
Public works	1,500,000,000
Public buildings	400,000,000
Privately-financed utilities	700,000,000
Farm construction	500,000,000

The critical material chiefly used in construction work is steel, the 1941 program requiring about 13,800,000 tons of steel ingots, roughly one-sixth of the year's total consumption. Of the amount used for building, approximately 6,300,000 tons are for non-defense construction, chiefly in industrial and public buildings. SPAB estimates indicate that under the restricted program, steel used in non-defense construction could be held to less than 3,000,000 tons. These savings would be partially offset by the fact that defense construction in 1942 would require about 1,200,000 more tons of steel than were used in defense construction during the current year.

It would appear that the 1942 outlook for the heating and ventilating industry must take into consideration not only the decrease in non-defense building, but the projected increase in defense construction.

Repair Order Amended

Another possible outlet for products of the industry is suggested by the October amendment to Repair and Maintenance Order P-22. In an effort to keep the American industrial machine in first rate repair, the P-22 order has been expanded to include practically everything except retailers, aid for whom appears to be in the offing.

The amended order grants the use of an A-10 rating to hundreds of thousands of industrial plants for obtaining maintenance and repair materials. It covers any governmental or private enterprise in many fields.

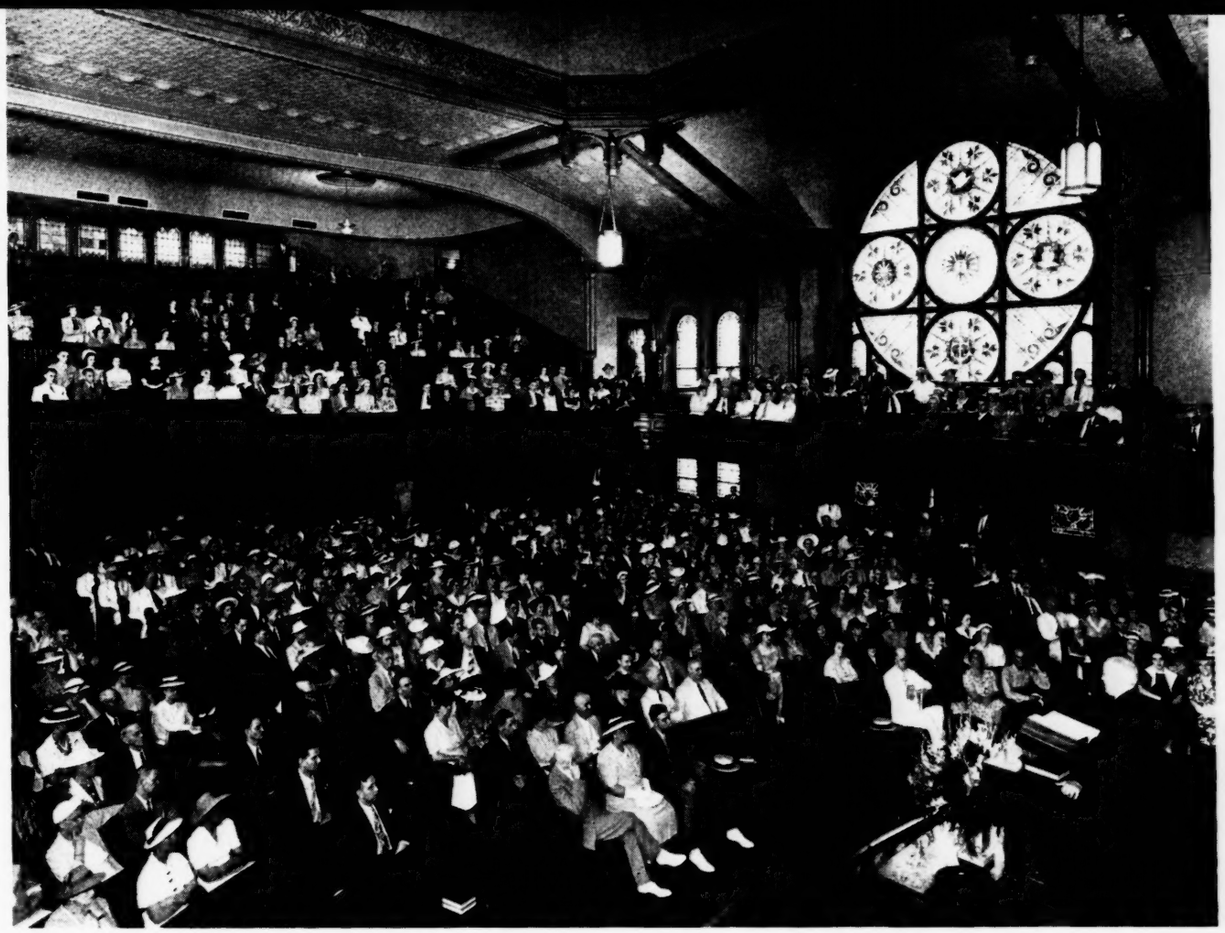
The principal condition of the P-22 order is that materials obtained must be used merely for maintenance or repair, not to improve or expand the plant. Copies of the Order, giving all conditions, may be secured by writing Priorities Division, OPM, Washington, D. C.

Specifications May be Simplified

Indicating a desire on the part of some OPM officials to smooth the way as much as possible on a road becoming increasingly difficult, efforts are being made to revise Cold Storage Plant Specification 8000E, Supplements E, F, and H, Addendum No. 1, and other facts pertaining to cold storage plants being installed by the Construction Quartermaster of the Army at various points in the country.

Revised specifications, including piping layouts, controls, loads and calculations, have been presented for the Army's consideration following a meeting called in mid-October by C. W. Shearman, head of the Air Conditioning and Refrigeration Section of the Equipment and Supplies Procurement Advisory Branch of OPM. Cooperating with Army engineers and

(Continued on page 72)



Air outlets above balcony in rear, and diffuser over large circular window, in the First Methodist Church, Birmingham, Alabama.

Southern Church Air Conditioned by Ice Storage System

By GEORGE H. WATSON

A MONTHLY saving of $100 in electric demand charge was made by use of a storage system as compared with a conventional intermittent system is reported for the all-year-around air conditioning installation in the First Methodist Church, Birmingham, Ala. The summer cooling system has a maximum capacity of 84 tons.

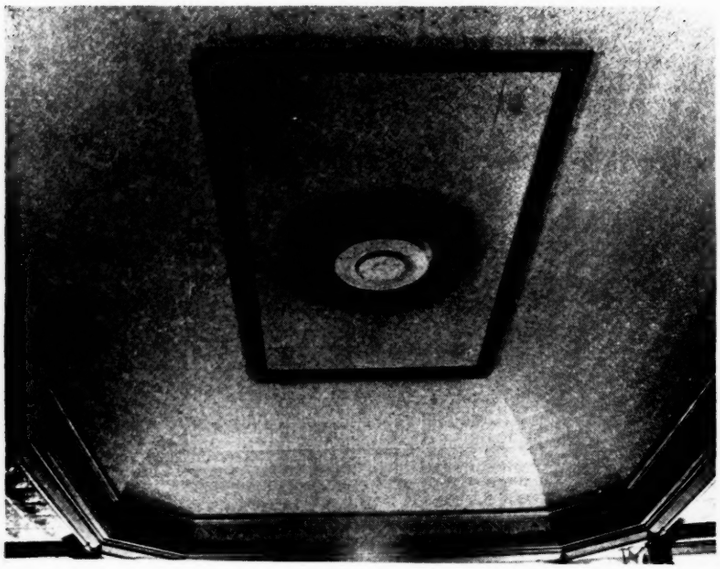
An ice storage system was chosen over a conventional direct system as being cheaper to install and to operate. Operating time for the equipment was figured on a basis of 8 hours per week including two services on Sunday and one on Wednesday night with sufficient time before these meetings to cool the church.

For a direct system to carry the load it was estimated that two 40-ton compressors of 86 hp would have been required. The storage system was figured on the basis of 10 hp. With the electric demand charge figured at $1.25 per kw this meant a saving in the demand charge of some $100 a month. The first cost of the job was estimated at $28,000 for a conventional system as compared with $22,000 using the ice storage method.

Immediate objective of the church in air conditioning was to replace a worn out blast heating system with steam coils, fan and ducts. One interesting feature about the old heating system, installed when the church was built 51 years ago, was that it included a large stone chamber designed to be filled with ice and air circulated over it for summer cooling. The system was ineffective, however, apparently on account of lack of fan capacity and sufficient contact of the air with the ice. The job does indicate, though, that the engineer a half century ago was at least thinking along the same lines as present day designers.

The new system was operated during the past summer and greatly stimulated attendance. The church has a membership of about 4,000 with over 1,500 in Sunday school. It is anticipated that the increased attendance with the resulting increase in the church offering will be more than enough to take care of operating expense for the summer cooling.

The ice storage system includes an 8-in. reinforced concrete tank, 32 ft long, 10 ft wide and 10 ft high, served by a Vilter Pak-Icer. This machine manufactures ice crystals at the rate of 5 tons per 24 hours and drops it by gravity into the tank, where it is spread out by an automatic leveling device, so as to utilize the additional storage space. The tank, made on the job, is insulated with 2 inches of Armstrong cork and located in the basement, half under the



(Left) Close-up of Air Devices air outlet installed in the center portion of the main ceiling of the auditorium. Unit is specially designed to blow the air angularly downward in a manner to pass below the dropped ceiling sections which surround this area. (Right) First Methodist Church, Birmingham, Ala., where ice storage system saves $100 per month on demand charge as compared with conventional system.

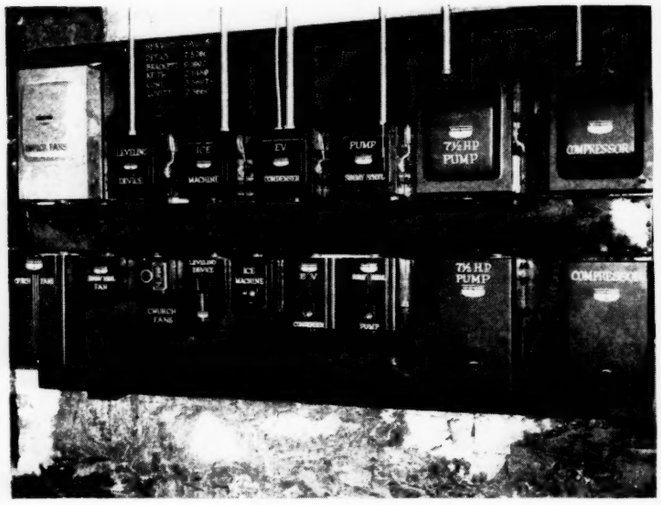
ground level. The tank has an ice capacity of 28 tons, so that the ice making equipment has a reserve capacity of 7 tons. The result is that normally the system automatically cuts off on Friday of each week unless there are additional meetings during the week to take care of.

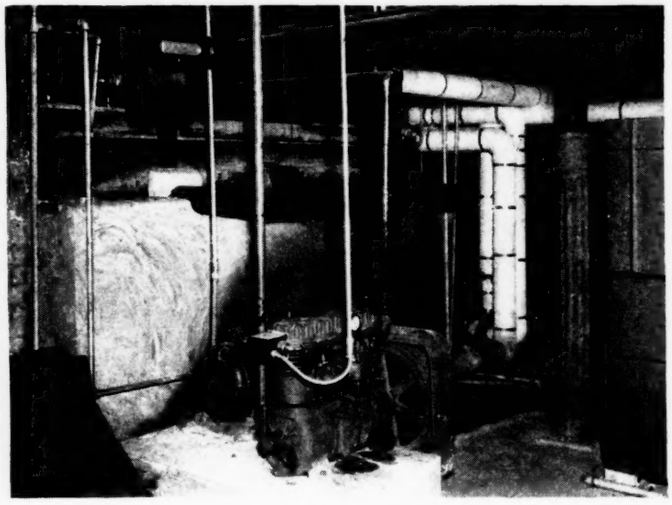
Other equipment in the basement includes a 7½ hp Carrier Freon compressor evaporative condenser, and a 7½ hp Allis-Chalmers pump which circulates cold water through copper pipes from the ice cold storage tank to the three air conditioning units located in the attic. The copper pipes are insulated with an ice water thickness of cork. The water is circulated and recirculated at 35F.

For cooling purposes the church auditorium is divided into three zones, although only one large space is involved. These zones are the balcony, the south side, and the north side. The fans handle a total of 26,000 cfm. This includes 6,000 cfm for the balcony and 10,000 cfm for each of the other zones. The fans have two speed motors, so air quantities can be reduced if desired to prevent drafts. From the conditioner the sheet metal ducts, insulated with 1 in. balsam wool, extend through the attic to Agitair circular outlets. Ample space was available in the attic, as in most churches, for the ducts, and outlets were cut through from the top, making scaffolding unnecessary in the auditorium.

The 6 ft center Agitair outlet, directly in the center of the ceiling over the auditorium, handles 12,000 cfm. This outlet is connected to the ductwork serving both the north and south zones. This unusual arrangement was feasible on account of the ceiling height of 32 ft.

Return air from the north and south zones is taken from the rear of the auditorium on the first floor, and from the hall adjacent to the balcony for the balcony zone. The old heating supply grilles were lowered to the floor level and used as relief grilles.





(Left) Control board for air conditioning equipment. "Leveling device" is metal arm which spreads ice through storage tank after it falls from icer. (Right) View in basement with compressor in background, the ice tank icer on top.

The air conditioning system was designed to take care of 1,200 people, 6000 cfm of outside air and 4,000 watts of light, and to maintain a temperature of 78F with 50% relative humidity when the outside condition is 95F dry bulb and 78F wet bulb.

The refrigeration system is completely automatic, and to start the three fans and pump it is only necessary to operate one switch. Each zone thermostat operates a damper motor controlling a set of face and by-pass dampers which give temperature control both summer and winter. Minneapolis-Honeywell controls are used.

Winter heating is provided by means of a Kewanee boiler, fed by a 225-pound-per-hour Fairbanks Morse stoker. The boiler is covered with 1-in. of Owens-Corning glass block insulation. The same pumps and the same copper pipes are used to circulate the hot water to the three conditioner units. Heating for the small auditorium is from the same system.

Artemus Lewis, of Miller, Martin & Lewis, architects, was in charge of the engineering. J. J. Keith and Wm. E. Cone were the engineers for the installer, Shook & Fletcher Supply Co.

Infection, Disinfection and Air Conditioning

The ideal of all-out air conditioning of any place occupied by human beings is the comfort and health of the occupants. Confinement of air for comfort (dryness or warmth) of the occupants may cause it to become vitiated, and ventilation aims to neutralize ill effects long regarded as unhealthy. Scientific developments have greatly extended man's control over his environment, and given him means of securing in confined spaces whatever physical or chemical conditions he may prescribe. Mechanical designs for controlling the quality of air in satisfying comfort requirements within confined spaces, unless due health specifications are satisfied, may favor the spread of contagion. . . .

Infection removal by ventilation is but one mode of air disinfection. Removal by other means can be measured by similar methods and expressed in terms of equivalent sanitary ventilation. Since the number of air changes per hour has been a useful measure of ventilation, the equivalent removal of one air change may be accepted as a unit of air disinfection.

Disinfection rates are not necessarily measured by bacteriologic techniques which measure air displacement. Air purification by settling, filtration or washing which readily removes coarse dust particles of little sanitary significance, as shown by petri dish exposures, might be relatively ineffective in removing fine nuclei infection of the greatest hygienic importance. A volume method of collection applied to test organisms suspended in nuclei would be required to measure disinfection. Settling methods might prove adequate to measure infected dust in hospitals. State of suspension is, therefore, a significant factor in comparing disinfection processes, and the determination of a coefficient of fineness is needed to interpret bacteriologic indices.

Biophysical phenomena enter into the measurement of disinfection by lethal radiation. The resonance band of mercury (2537 Å), which is strongly bactericidal and can be generated economically, provides a practical disinfecting agent. It is highly absorbed within the minute dimensions of nuclei (perhaps the necessary condition of disinfection of particles in air), but having little penetrating power may be less effective against bacteria trapped in larger particles, and the state of suspension of the particles may again have an important bearing upon the disinfection rate. A method suitable for measuring disinfection rates of bacteria in fine nuclei of droplets expelled from infected respiratory passages may not directly measure the disinfection rate of dust in hospital cross-infection.

The measurement depends upon biological factors such as the difference in vulnerability of pathogenic organisms, which generally varies little from that of *E. coli*. Spores are more resistant than vegetative cells, and the tubercle bacillus is somewhat more resistant. Apparently influenza virus and, judging by our epidemiologic experience, the viruses of measles, chickenpox and mumps are equally sensitive. The general conclusion that different pathogenic microorganisms are more uniformly sensitive to lethal radiation than to thermal or chemical disinfection seems to be justified.

Technical details emphasized in the standardization of disinfectants must, of course, be controlled in bacteriological tests of radiant disinfection. The test is dependent upon other physical factors than state of suspension. While temperature can usually be disregarded, the pronounced change in vulnerability to lethal irradiation resulting from even slight changes in relative humidity between 55 and 75% may greatly affect the interpretation of results obtained under humid conditions. Fortunately the greatest need for radiant disinfection comes in the winter when the humidity of warmed inside air is usually below 50%.

In view of the arbitrary nature of any practical method of measuring radiant disinfection, hygienic interpretation depends upon the correlation of the results of such tests with epidemiological experience. To avoid misunderstanding as to the purpose of results expressed in equivalent air changes determined bacteriologically, it may be advisable to define a unit of lethal irradiation which removes a proportion of test organisms equivalent to one air change as a lethe. Lethal exposure in unit time then defines disinfection intensity, and a foot^3-lethe would have the same value in ventilation as a cubic foot replacement with air free of the test organisms.—*Abstracted from a paper by William Firth Wells, associate professor of research in air-borne infection, University of Pennsylvania School of Medicine, presented before a meeting of the American Association of Industrial Physicians and Surgeons and the American Industrial Hygiene Association.*

ABSTRACTS of Current Papers, Books and Pamphlets

Heat, Theory and Practice

The aim of the author of this book has been to produce a book on heat and its relation to refrigeration and air conditioning which would give a clearer understanding of the basic factors underlying these arts. In other words, the purpose of this book is not to answer questions directly or solve specified problems but to give information which, when mastered, will enable the reader himself to answer the questions and find the solutions for any problem which may arise in this connection. Included in the chapter headings are: Historical Sketch; General Survey; Essential Nature of Heat; Some Essential Properties of Heat; Heat and Work; Relation of Heat Energy to Mechanical and Electrical Energy; Reaction of Material Bodies to Heat Energy; Heat Transfer; Temperature; The Nature of Vapor; Heat Principles in Refrigeration and Air Conditioning; Principles of Refrigeration; Refrigerants; Problems Arising in Refrigeration and Air Conditioning; Insulation; Refrigeration and Air Conditioning Machinery; Theory of Radiant Heat.

[*"Heat in Theory and Practice," by Samuel Richard Cook. Published by Nicherson & Collins Co., 435 N. Waller Ave., Chicago, Ill. Cloth bound; 6 x 9 in.; 228 pages. Price, $2.*]

•

Temperature Control

A treatment on the theory and practice of temperature measurement intended primarily for use as a textbook but also of considerable value to engineers, particularly those engaged in operation and who are concerned with power, air conditioning or other heating processes. The author is a member of the staff of the school of chemistry and physics, The Pennsylvania State College.

The book is arranged in three parts, the first devoted to principles utilized in temperature measurement by expansion, thermoelectricity, radiation and resistance. Related topics such as calorimetry, thermal analysis, temperature control, elementary thermodynamics and temperature scales are outlined in this section. Part 2 consists of 24 laboratory experiments designed to illustrate the methods discussed in the first section while Part 3 is an appendix of 24 tables of data.

[*"Temperature Measurement and Control," by Robert L. Weber. Published by The Blakiston Company, 1012 Walnut St., Philadelphia, Pa. Cloth bound; 6 x 8½ in.; 430 pages. Price, $4.00.*]

•

BRIEF REVIEWS

Air Conditioning. An impressive assembly of information on the extent to which air conditioning increases profits in different kinds of businesses and professions. Each of the brief but meaty papers in this book was prepared by a business paper editor familiar with the fields covered. The papers, presented at Chrysler's Round Table Clinic on Air Conditioning June 5, cover such businesses as restaurants, hotels, grocery stores, drug stores, beauty shops, jewelry stores, laundries, banks, funeral parlors, drygoods and department stores, shoe stores, printing plants, machine shops, candy plants, hospitals, doctor's and dentist's offices. [*"How Air Conditioning Builds Business Profits." 53 pages; paper cover; 8½ x 11 in. Available from Airtemp Division of Chrysler Corporation, Dayton, Ohio.*]

Radiant Heating. The first two of a series of case histories of radiant heating installations. Case Study No. 1 is that of a small residence in Pennsylvania while No. 2 is that in a $15,000 office building in South Carolina. Each of these bulletins includes the names of the individuals responsible for the design and installation; a description of the system; and information available on the performance of the plant. Information is sufficiently detailed to make the studies of considerable value to designers and installers. [*"Case Study No. 1—Radiant Heating in a Small Residence," and "Case Study No. 2—Radiant Heating in a $15,000 Office Building." Published by A. M. Byers Company. Each 4 pages; 8½ x 11 in. Available from A. M. Byers Company, Pittsburgh, Pa.*]

Research. A 54-page booklet describing current activities of the ASHVE Committee on Research and listing, by name, all of the sub-committees on various research products and, for each, including information on committee personnel, scope of the project and an outline of research investigation on the project. A valuable feature of the book is the bibliography of research reports. [*"Programs of the Research Technical Advisory Committees of the American Society of Heating and Ventilating Engineers." Published by the ASHVE, 51 Madison Avenue, New York. Paper cover; 6 x 9 in.; 42 pages.*]

Fuel Saving. A folder for house owners entitled Furnace Heating Guide and covering in simple terms such subjects as comfort factors, choice of fuel, furnace inspection, chimneys, cleaning, modernizing, stokers, controls, insulation, firing methods and heating costs. [*"Furnace Heating Guide," by K. C. Richmond, editor of Coal-Heat. 20 pages; paper cover; 4 x 8¾ in. Available from Coal-Heat Magazine, 20 W. Jackson Blvd., Chicago.*]

Vocational Monograph. John T. Schaefer, formerly of General Electric's Air Conditioning Division, has prepared a vocational and professional monograph on air conditioning. The booklet, one of a series of vocational monographs, discusses air conditioning from the standpoint of those selecting a vocation. [*"Vocational and Professional Monographs—Air Conditioning," by John T. Schaefer. Published by Bellman Publishing Company, Inc., 6 Park St., Boston, Mass. Paper cover; 6 x 9 in.; 20 pages. Price, 50 cents.*]

NEWS OF THE MONTH

Threatened Fuel Oil Shortage Reported as Over by Ickes; Return of Loaned Tankers, Use of R.R. Cars are Factors

WASHINGTON—Apparently due to a combination of circumstances and events, there is no longer a threatened oil and gas shortage on the Eastern seaboard. At least the October 23 announcement of Petroleum Coordinator Ickes, who for months has claimed that the shortage would exist, indicates that the shortage will not materialize.

Factors tending to rectify the shortage, originally caused by the loan of eighty tankers to Great Britain, are the return of a number of these ships, a mild fall during which little fuel oil has been used for building heating, efficient use of railroad tank cars, and increased loading of available tankers.

The British arranged by Nov. 30 to release twenty-five tankers from the "shuttle" service between Caribbean ports and Halifax, in addition to the fifteen tankers obtained from the United States which it was agreed originally they would turn back, the Oil Coordinator disclosed.

In the agreement, reached here between Sir Arthur Salter, representing the British Government, and Mr. Ickes, as the principal negotiators, it was stated that Britain could get the tankers back if she needed them and noted that the future was uncertain. The agreement was formalized in a statement by Sir Arthur and a letter issued by the United States Oil Coordinator.

Whether the return of the tankers from Britain had any relationship with the questions raised in the Senate regarding England's use of tankers for her commercial oil trade is not known.

Mr. Ickes said that twelve oil companies, using rail transportation at an "unprecedented level," moved 4,396 tank cars of petroleum and its products to the East Coast in the week ending Oct. 18.

"It means that we are moving steadily forward in the job of relieving, and, if possible, entirely eliminating, the East Coast transportation shortage," the Secretary then stated.

Later Mr. Ickes's office revealed that East Coast inventories have approached last year's levels. Stocks for the week ended Oct. 18 were only 476,000 barrels less than in 1941, as compared with 9,000,000 barrels less when Mr. Ickes began his campaign.

WASHINGTON — Fifteen of the oil tankers diverted to British use have been released subject to recall and are being restored to their owners for normal services. It is understood here that all of them will have been returned by the end of October.

Officials said that the transaction was in accordance with the announcement of Oct. 7 that the British expected release of fifteen tankers from the shuttle service in which they had been engaged, carrying oil from Gulf ports to points on the East Coast north of Cape Hatteras from which shipments could be made to Europe.

It was said that conditions were such that these tankers could be released without jeopardizing British interests, thus making possible relief of the shortage of petroleum products in the East.

Supplies of fuel oils and motor fuel and demand alike exceed previous high levels of production and estimated future requirements, according to the monthly petroleum forecast, made public Oct. 21.

SMA Elects J. M. McClintock

CHICAGO—J. M. McClintock, Chicago, manager, Free-Man Stoker Division, Illinois Iron & Bolt Company, has been appointed interim President of the Stoker Manufacturers Association. Mr. McClintock succeeds Frank Hoke of Indianapolis, who resigned to become Indiana state director of contract distribution service for OPM, with headquarters in Indianapolis.

R. W. Conkey, Mendota, Illinois, was appointed treasurer of the Association to succeed Mr. McClintock. E. C. Sammons, Portland, Ore., vice-president, Iron Fireman Mfg. Co., takes the place of Mr. Hoke as chairman of the stoker industry's national defense committee. The members of this committee, in addition to Mr. Sammons, are: Louis Schwitzer, J. M. McClintock, G. Walter Ostrand, and Marc G. Bluth, secretary of the Association.

New members of the Association are as follows: Schwitzer-Cummins Company, Indianapolis; David Bradley Manufacturing Works, Bradley, Ill.; Eddy Stoker Corp., Chicago; Grossenbacher Furnace Company, stoker division, St. Louis; Stok-A-Fire Company, St. Louis, and Kingston Products Corp., Kokomo, Ind.

Ely Heads Pittsburgh Smoke Bureau

PITTSBURGH—Appointment of Sumner B. Ely, consulting engineer, to head this city's new Bureau of Smoke Prevention, was announced Sept. 11, after Samuel R. Tobias, who had been previously named to the position, declined to serve.

The new appointee is associate professor of mechanical engineering emeritus of Carnegie Institute of Technology.

AIR CONDITIONED BOMB SHELTER

(Left) First air-conditioned bomb shelter exhibited in the U. S. Built of steel, the bomb shelter has been equipped with a Chrysler Airtemp 3-hp air-conditioning system for the safety and comfort of occupants. (Right) Interior of the shelter, which is built of 7-gauge corrugated steel of high flexibility, and is designed to be buried under at least 3 ft of earth. Actually, it fits into a built-up steel box, which leaves an insulating space between the box and the rounded parts of the shelter, thus providing additional protection. The air connection enters the air-raid shelter through a stack at the center.

Proposed New Jersey Law Calls for Industrial Hygiene Department to Supervise Industrial Ventilation where Hazards Exist

TRENTON, N. J.—Increased safeguards for New Jersey industrial workers against toxic fumes, dust and other dangers which have been increased by defense production activity and in the alleviation of which ventilation and air conditioning would play a vital role, are sought through legislation pending in the State Legislature here.

Importance of early action to provide greater protection for workers in the state's industrial plants has been emphasized by State Labor Commissioner John J. Toohey, Jr., whose department is charged by law with the task of finding sources of a steadily growing list of occupational diseases which are killing or disabling hundreds of workers each year.

"New Jersey," Commissioner Toohey declared, "has 670,000 men, women and minors working in 11,000 industrial plants and is the only state in which suitable provision has not been made to safeguard the health and lives of those employed in the dangerous trades.

"We're doing the best we can, but it's far from being enough—what with no money and a bureau of hygiene and sanitation mainly on paper.

"Since the national defense program started, the situation is getting worse. New Jersey is one of the largest chemical producing states. Hundreds of workers are now exposed to occupational diseases we never dreamed existed—persons who have no idea that they are so exposed. All they know is that they have jobs and want to be able to do the work they have to do, relying on their bosses and this department to safeguard them from toxic fumes, dust and the like."

A legislative effort to meet the situation is represented in Assembly Bill No. 484, which provides for a bureau of hygiene and sanitation personnel, functioning in the state labor department, and an appropriation of $31,000 to start the work. Introduced June 3 by Assemblyman David Young of Morris County, the bill has been held up by a squabble on the point of supervision, with some arguing the work should be done by the state labor department and others contending it should be done by the state health department. With increasing demands for action coming from labor unions, the press and others, however, it is expected that the bill will be moved when the State Legislature reconvenes Nov. 13 after a recess.

Commissioner Toohey has disclosed that if Assembly Bill 484 becomes law, New Jersey can obtain gratis the services of Dr. Harrison S. Martland, chief medical examiner of Essex County and a prominent industrial disease expert, as supervisor and consultant of the bureau. Under the proposed setup, Dr. Henry R. Kessler, medical director of the State Rehabilitation Commission, would serve as medical director of the bureau, also gratis.

When Assembly Bill 484 was introduced in the State Legislature here, the New Jersey State Medical Society followed the lead of the Public Health Service and opposed the measure through its legislative committee. Explaining the society's opposition to the bill, Dr. Frederic J. Quigley, executive secretary, said:

"The State Medical Society is opposed to it because we believe the setup provided for in the bill is entirely wrong. It would not be an efficiently functioning bureau.

"The bureau should be under supervision of a qualified industrial physician, trained in industrial hazards. We feel this is a medical problem, not an engineering problem, and our feeling is also that the bureau should be a subdivision of the State Department of Health.

"The United States Health Service has made available to New Jersey the services of such a physician in addition to a chemist and a hygienist. In addition, federal money is obtainable by the State Department of Health for such work.

"The state society feels that a bureau of that sort is long overdue in this state and is heartily in accord with the objective, but not with the setup provided for in Assembly Bill 484."

Commissioner Toohey declared: "I have no desire to get into a controversy with the State Department of Health. The work should be done by somebody, and the sooner the better. But whichever department has it should be completely in charge. The Labor Department has police power to go into plants whenever anything is wrong and that helps in the enforcement of rules or orders in connection with occupational diseases."

A previously proposed compromise plan to settle the dispute by splitting the work between the health and labor departments met with failure, apparently being objectionable to Dr. J. Lynn Mahaffey, head of the state health department, as well as to Commissioner Toohey.

Last year four persons died in New Jersey, three were permanently disabled, 137 suffered permanent partial loss of a function and 393 were temporarily disabled because of occupational diseases due to handling or inhaling poisonous and corrosive substances according to state labor department records.

Fleisher Speaks in Washington

WASHINGTON—The Washington chapter of the ASHVE Heating and Ventilating Engineers at its first meeting of the year October 13, heard national ASHVE president Walter Fleisher speak on the contribution of the Society and its members to defense. Among these contributions is research on heating of cantonments, fever therapy in treating venereal diseases, and the research in design of clothing for soldiers and sailors for hot and cold climates.

Francis J. Trecker of OPM spoke on the activities of the subcontracting division of OPM.

F. A. Leser, new local president, presided and Lt. Comdr. Urdahl, USNR, served as toastmaster.

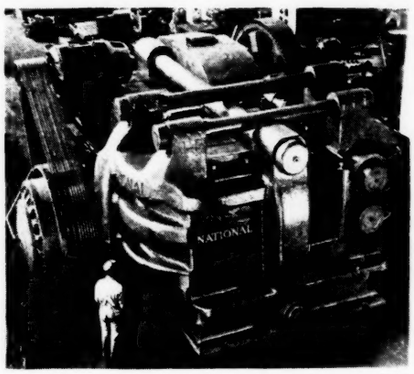
Air Sanitation Course Begun

DETROIT—The University of Michigan is offering 23 courses in engineering, science, and management as part of the Defense Training Program beginning October 13 and continuing for eight weeks.

Included in the courses is one on air sanitation in industry covering types and sources of air contamination; effect on worker's health; identification and measurement of contaminants; remedial measures for dusts, fumes, gases, noise, odors, heat, humidity and radiations.

The course on air sanitation is under the direction of W. H. Witheridge. All of the courses are sponsored by the United States Office of Education.

WORLD'S LARGEST FORGING MACHINE



Attention is being focused on the current delivery of the world's largest forging machines one in November and the other in February to Tube-Turns, Incorporated, Louisville, manufacturers of welding fittings. Because these forges represent a far-reaching development in the scope and capacity of forging operations, industry and defense bodies are keenly interested in their performance at Tube-Turns, Inc. Here they will be put to work immediately in the production of airplane motor cylinder forgings and other armament needs. These two forges are rated at 9 in. capacity. Each machine weighs over 500,000 lb. and requires well over a year to build.

Housing Curb Explained by OPM Official at New York Meeting; Urges Spreading Out of Available Professional Work

NEW YORK—Radiator heating is being discouraged, the SPAB curb on housing means exactly what it says, and architects and building industry engineers need representation in Washington to sell the idea of proper distribution of available work, according to Sullivan W. Jones, Chief of the Housing Priorities Branch of OPM, speaking before the New York Building Congress here October 15. Abstracts from Mr. Jones' talk follow:

"This whole matter of housing is divided from the functional standpoint between two or three government agencies. Charles F. Palmer, as Defense Housing Coordinator, is responsible for the program. Mr. Palmer's function is that of saying where and how many and, in some cases, why. He has set up the defense housing program on the basis of local surveys and reports on existing conditions, but of course the whole picture is kaleidoscopic.

"So that I have taken the position that the program as it was laid down on September 21, that is, the list of defense areas and the quota of houses or units for each area, including our so-called housing critical list, which is the document controlling the use of metals in housing, always constituted merely a chalk line from which we were going to start this vast enterprise of building houses which the country needed to domicile its defense workers.

"A tremendous amount of pressure is being put on private defense housing to encourage private enterprise to go into the field and to expand that field to the *n*th degree. Mr. Palmer's estimate is that by July 1, 1942, we shall need 525,000 new single family units in one form or another. Of that 525,000, Mr. Palmer thinks that public housing should take care of 100,000 and that private enterprise should take care of 425,000. Now, when the machinery for extending priority aid to housing was set up, the top board of OPM decided that it would be unwise to go overboard on the total program, and so approved as a starter a program comprising 300,000 units, 100,000 of which were to be publicly financed, and 200,000 to be produced by private enterprise.

"My own feeling is that Mr. Palmer's estimates of the amount of housing that private enterprise will produce is perhaps a little off what we are actually going to secure. Viewing this thing as an investor would view a housing project, I don't believe that he is going to get private enterprise to produce 425,00 houses or units by next July. Of course, the minute a plant is put in the middle of a prairie, you need housing, but it seems to me quite incredible that private enterprise is going to follow that plant out in the middle of the prairie and build a ghost town of the future; nor am I convinced that the workers in that plant are willing to hang themselves upon a twenty-year mortgage contract. They are going to want to rent houses, rent accommodations. As long as they want to rent them, and we don't know how long the demand or use is going to be there, I think we are a little over-optimistic in assuming that private enterprise is going to furnish such accommodations.

"In setting up this machinery for issuing preference ratings to housing —or as we express it in Washington, priority assistance — if we attempted to issue those preference rating certificates, the entire corridors of the Social Security Building would be filled with guests and clerks and stenographers and files, and we would develop a bottleneck in OPM the like of which OPM had never seen before— and they have had some bottlenecks. So we decided to go down into the field, to extend the thing as far as possible, and reduce the amount of table work in Washington. We looked around for an agency to function for us in the field, and we naturally selected FHA which had 137 branch offices, all of them personnelled with experienced technicians who are there ready to do the job. So we practically annexed FHA, and we said to FHA here are the criteria, here are the standards, you process these projects, these applications, and tell us whether or not they qualify as defense housing.

"The housing then passes from FHA, still in the field, to Mr. Palmer's representative in the field who checks the application and the housing which it covers against his program, and if he is satisfied that it is a properly coordinated part of the program then he transmits the application with his okay to the local OPM district manager who issues the preference rating order. This is the first time that preference rating orders or priorities have been issued in the field. Heretofore, they have all gone to Washington for final documentation. I am hoping that this thing is going to work so well and so expeditiously that some of our other orders are going to be issued in the field and take some part of the paper work and the resultant load out of Washington.

"Then we laid down certain other restrictions. One was that no defense house should be offered in the market, including land, for a price in excess of $6,000, nor should any one family unit be offered for rent in the market at a rent in excess of $50 per month. We have been severely criticized for putting those ceilings on rent and ownership, but I know, and everybody who builds small houses knows, that you can build a house anywhere in the United States, a livable house suitable for defense workers, and sell it with the land for less than $6,000. We are standing pat on that in spite of the pressure which is coming to Washington on this all the time from the real estate interests, and from the fellow who subdivides land and builds houses and would like to sell them for $7,500.

"All construction must go ahead on what I call a balanced bill of quantities of metals. We may build houses, and put in plumbing; we may put in the heating, and then find we can't get copper for electric wires, and then you haven't got a house, so that the housing must go forward on a balanced bill of quantities of metals, and the controlling metal in that whole picture is copper. We have to take our program, our required housing program of 525,000 units up to July 1, 1942, and we have got to take the available poundage of copper that we may use in housing, and we have got to spread it over our program, and believe me, we are spreading it thin.

"In order to economize in the use of copper, we have had to cut down the number of outlets permitted per room in electric wires. We are going back to the old system of drop-cords for receiving outlets. In defense housing you cannot use brass pipe nor copper tubing; you can't use cast brass traps, so that we have reduced very materially the amount of copper that goes into plumbing, and we are doing the same with heating, and we are urging the house builder to use the floor type of furnace or the space heater properly installed, insulated, and with a circulating system, so that the entire small unit is properly heated. We are trying to discourage the use of cast iron boilers involving the installation of an enormous amount of piping, and cast iron radiators because the situation is extremely acute. You can't get it, and what we can get, we need for cast iron pipe. We will have to get along without the use of cast iron in our heating systems as far as possible.

"We don't have such an acute shortage on steel, but nevertheless there is an acute situation on steel. We are going to work on the whole question of plumbing, and we have now prepared a defense housing plumbing manual. I want to take my hat off to the Master Plumbers and to the plumbing unions of the United States. We have reduced the amount of metal used in a one unit plumbing installation some 200 lb. These fellows have agreed to things because of the neces-

(Continued on page 68)

Friction Among Housing Heads Being Studied by Rosenman; Coordination of Agencies Involved is Objective

WASHINGTON — On the request of President Roosevelt, Supreme Court Justice Samuel I. Rosenman of New York is investigating all the Federal agencies handling housing, both civilian and defense construction, with a view to making recommendations for coordinating the work of these agencies, centering administration and policy-making in the same hands and eliminating duplication, over-lapping and nating duplication, overlapping and waste, it was reported Oct. 13.

Following a conference with a score of housing agency chiefs or their chief assistants over that week-end, Justice Rosenman obtained a mass of information, some of which dealt with the feuds and rivalries among the various organizations dealing with housing. Justice Rosenman gave no indication as to the trend of his thought on the confused housing situation and the divided authority among those responsible for public housing. Nevertheless, some of those who are familiar with his inquiry believe that it may look toward having defense housing, at least, concentrated in one straight-line organization, if that is feasible, or so coordinated that the responsibilities of the agencies are placed in efficient hands. Whether this may mean removal of some of those handling housing problems was not clear but it is likely that some aspects of defense housing may be placed in new hands as the result of the inquiry.

Among Federal agencies dealing with housing whose officers conferred with Justice Rosenman were FWA, USHA, the United States Housing Coordinator, PBA and FHA.

Justice Rosenman learned of the displeasure among the various housing agencies as well as among officials of SPAB at the award of all authority over housing priorities to C. F. Palmer, Coordinator of Housing and head of the division of defense housing of the Office of Emergency Management.

Mr. Palmer made himself independent of SPAB by having the President sign a letter the day after the new agency was created. Under this authority he passes on requests for priority made by any of the housing agencies and is even independent of Donald Nelson, executive director of SPAB.

The principal argument advanced by those who spoke with Justice Rosenman about the friction between Mr. Palmer's office and that of the other housing agencies was that while each agency is responsible for administering policy, that policy is made by Mr. Palmer. Both the policy-making function and the administration, it was suggested, should be in the same hands.

Justice Rosenman's inquiries, however, were by no means directed solely to the personal relationships of those who are responsible for government housing construction, but he probed deeply into the expenditures, the methods of construction, including prefabrication, and the ability of the agencies to carry out the duties allotted to them.

On October 29 Nathan Straus, administrator of the United States Housing Authority, told the Senate committee investigating defense expenditures that his organization had secured only "dribbles" of funds to continue defense housing, and declared that other Federal agencies which had received most of the funds had failed to deliver.

As a result, Mr. Straus predicted "the most desperate housing conditions in defense centers this winter, dangerous congestion, all of which could have been avoided if there had been an early enough recognition of the real housing need and if the tested machinery of established housing agencies had been used to meet that need."

Mr. Straus protested that the Federal Works Agency and the Defense Housing Coordinator Charles F. Palmer, had put the USHA in last position as a defense-housing agency. He further charged that Mr. Palmer held things up by insisting on a review of USHA priority applications for building materials. At one point in his prepared statement, Mr. Straus spoke of other Federal defense housing agencies as "competitors," and said he used the term advisedly.

Mr. Straus invited the Senators to question him and members of his staff who accompanied him to the hearing room. The committee counsel, Hugh A. Fulton, told Mr. Straus that two aids who had surveyed the USHA office for two months reported "absolutely nothing to criticize."

Thereupon Senator Truman, the chairman, adjourned the hearing without questioning Mr. Straus or his staff.

In reviewing the defense housing picture, Mr. Straus recalled to the committee that a year and a half ago he asked Congress to put the job in his hands. This Congress did not do, except to make available unspent or unobligated funds for certain small housing projects which Mr. Straus said were completed in satisfactory time.

"At the precise moment when it was imperative to make the most efficient use of existing machinery, new and untried devices were resorted to," Mr. Straus said, opening his attack on other defense housing agencies.

First, he recounted, $100,000,000 was given to the Army and Navy for defense housing. He did not criticize these services, saying that "they have not demonstrated preparedness to do this kind of work, especially as to operation and maintenance," but "I am sure they are doing a marvelous job in providing a two-ocean Navy, an effective Army and a strong air force."

However, this approach to the problem was wrong, said Mr. Straus, and he added that it had aggravated "its basic defects."

Next, said Mr. Straus, FWA Administrator Carmody had apportioned a share of defense housing funds to PBA which, he said, had made a splendid record in building postoffices and other similar edifices but had not developed housing projects. He called this "the initial mistake," and said that since then the FWA had moved gradually in the direction of extricating the "defense housing program from the inexperienced hands of PBA."

Then, said the USHA chief, Mr. Carmody established a division of defense housing which, he said, was no more justified than creating a defense agency for roads within the Federal Bureau of Roads. He said also that it was "pernicious and costly in government," and declared that the division of defense housing had recruited much of its staff from the USHA.

Next, said Mr. Straus, other agencies such as the TVA and the Farm Security Administration sought defense housing funds and because of this, most of the available money was allocated. But, he went on, "the Federal Works Administrator allowed some funds to dribble through to the USHA and local housing authorities. The tested and existing machinery, instead of being the spearhead of defense housing, was allowed to survive by sufferance."

Management of some of the defense housing projects by other than USHA was criticized by Mr. Straus as unwise, and he contended that the experience of his organization plus the cooperation of local agencies was necessary to efficient solution of the problem of tenancy.

Air Filter Paper Presented

LOS ANGELES—A paper on the Design, Construction and Theory of Air Filters was presented at the October meeting of the Los Angeles chapter of the National Association of Practical Refrigeration Engineers by R. S. Farr, design engineer of Temperatair, Inc., Los Angeles.

Mr. Farr gave an outline of the development of filters and filtering processes, together with a discussion of filter practices and equipment.

A.C. Standards Work Begun

LOS ANGELES — With the ASHVE chapter's program for drawing up standards of air conditioning installations having received the endorsement of the Better Business Bureau of the city and the bureau's promise of cooperation in the dissemination of truthful advertising concerning air conditioning in Southern California, the chapter's standardization committee on October 15 broadened its program by beginning a series of detailed inspections of typical installations in the metropolitan area.

The plant inspections are being made by the committee under the direction of Chairman B. H. Harris. The plan calls for each committeeman to make personal studies of two or three installations, which will be augmented by studies of jobs made by other members of the chapters. The investigators will report their findings to the chairman for reference when the final drawing up of standards to govern design and installation is undertaken.

In apportioning the work of the committee for the last quarter of the year, Mr. Harris has assigned to each committee member a different phase of air conditioning. All information dealing with duct work, for instance, will be channeled through one committeeman who will correlate it for the committee as a whole. Other committeemen will handle such subjects as humidity, air control, location of compressors, and amount and type of air volume.

The object of the committee is to provide not only a uniform basis for designing and installing air conditioning systems but also to distribute truthful information regarding air conditioning. The time is past in Southern California, chapter president Arthur Hess declared, when any hotel or apartment house equipped with a forced draft furnace can be permitted to advertise itself as being "air conditioned."

Proposes Survey of Urban A.C.

NEW YORK—A comprehensive survey of all air conditioned buildings, auditoriums and other large shelters in New York City, to uncover necessary and vital information in case of air attack, was advocated by D. A. Newton, air conditioning engineer, Carrier Corporation, before the New York Building Superintendents' Association at its October meeting here.

"In some large Eastern cities, some surveys already have been made to find air conditioned auditoriums and buildings where large numbers of persons can be crowded together comfortably in case of possible air raids," Mr. Newton revealed.

OPM Restricts Use of Copper for Civilian Applications

WASHINGTON — Use of copper as a component in more than 100 types of civilian articles is restricted by 40% for the rest of the year and prohibited after Jan. 1, according to terms of an order issued Oct. 20 by the Division of Priorities of the Office of Production Management. Among these articles are the following: Air conditioning equipment (except small moving parts and bearings); grilles; plumbing and heating supplies; bands on pipe covering; convertors and local heaters; fixture fittings and trimmings (excluding valve seats); hot water heaters and coils (except as provided in Defense Housing Critical List issued by Director of Priorities, Sept. 12, as the same may be amended. Pipe fittings (except as provided in Defense Housing Critical List issued by Director of Priorities, Sept. 12, as the same may be amended); ventilators and skylights.

The four-point order is intended to assure adequate copper supplies for defense needs for this year and to avert a threatened shortage of 750,000 tons next year.

Immediate curtailment of 40 per cent in the use of copper for specific civilian articles is ordered, a curb of 30 per cent is fixed on civilian items not included in the list and the use of the metal in construction is prohibited after Nov. 1, except for wiring.

The order does not apply to Army, Navy, lease-lend and government agency contracts, although even in those fields officials are experimenting in the hope of finding substitutes for brass and copper.

Other exceptions allow copper for use in products covered by underwriter or other safety regulation in effect Oct. 1; in condenser or heat exchanger tubes (other than radiators used to control air temperature); as a conductor of electricity; in chemical plants where corrosive action makes other materials impractical; in research laboratories if wood, glass or enamel substitutes will not serve; in steam generating plants and oil refineries and in hydroelectric plants.

According to OPM officials the actual savings based on the current rate of consumption will amount to 200,000 tons next year.

In a special provision, any person affected by the order who considers that compliance would work an exceptional and unreasonable hardship, or result in a degree of unemployment which would be unreasonably disproportionate compared with the amount of copper conserved, will have the right to appeal to the Director of Priorities, asking an exemption.

Dew-Point Device for Freezing

DENVER—To prevent condensation of moisture and possible freezing of its gas lines during the winter months, the Colorado Interstate Gas Company has built a dew-point recorder utilizing a General Electric photoelectric relay. With the recorder, continuous readings of temperature at which condensation occurs are made where the gas enters the Denver metering plant. If calculations based on the readings show the dew point to be too high, instructions are dispatched to dehydrating plants to remove more moisture before trouble occurs.

The equipment consists of a small tank filled with antifreeze solution into which is immersed a U-shaped highly polished gold-plated tube. Through this tube passes a continuous flow of natural gas from a by-pass valve in the main pipe line. Both ends of the tube are provided with plate-glass windows. Above the windows, a light source and photoelectric relay are mounted so that the light shines through the tube and is reflected to the phototube.

For controlling the temperature of the antifreeze solution, the tank is cooled with coils of a small domestic refrigerator and heated with suitable strip heaters. As the cooling system reduces the temperature of the solution, the gas is chilled until a film of condensate is deposited on the inside of the highly polished tube, thus reducing the reflection of light to the phototube.

Being sensitive to a change of ½ foot-candle, the phototube operates to disconnect the cooling coils and connect the heaters to warm the solution. When the solution is warm enough, the condensate disappears and the process is repeated. A small motor-driven stirring paddle in the antifreeze solution equalizes the temperature of the bath.

A recording-bulb-type thermometer immersed in the solution records the temperature of the solution.

Describes Use of Ultra-Violet A.C.

CHICAGO—How a virtual barrage of powerful ultraviolet rays destroys disease germs in mid-air and promises a new control over air-borne epidemics in wartime was described by Dr. H. C. Rentschler, director of research for the Westinghouse Lamp Division, addressing a symposium of scientists and engineers gathered at Dora DeLee Hall, Lying-in Hospital to consider the use of ultraviolet air conditioning as a safeguard against the spread of disease in draftee camps, barracks, schools, and public buildings. The meeting was sponsored by the American Association for the Advancement of Science.

News of the Month

Priorities Discussed in Boston

BOSTON—Members of the Air Conditioning Bureau held their first fall meeting Oct. 27, with two guest speakers, George R. Glendining, president and editor of the *Banker & Tradesman* and Roger Woodman, analyst, of the Boston office of OPM. Both spoke on priorities. Mr. Glendining talked on "A Businessman's Viewpoint on Priorities," and Mr. Woodman explaining various rulings in priorities and their effects on the air conditioning industry. Later there was a period of questions and answers which helped to iron out many individual problems of members present.

Mr. Glendining said that priorities had helped the banks to get rid of much of their foreclosed real estate, which had been on their hands for years, and called attention to the fact that there are as yet no priorities on such building materials as lumber, bricks and cement, although there are on metals and that builders could go ahead as far as they could procure materials in the first named fields, although they could only secure metals for necessary repairs to buildings at present. The banks are doing all they can in the matter of loans for construction, especially for national defense work and building repairs. He urged the members to get together with other organizations for modernizing of building codes in the cities and towns, which he said were operating on codes and regulations dating almost as far back as Noah's Ark. If building is restricted now, he said, it will mean a burst of home building after the emergency is over and he urged members to use every possible influence to keep building in private hands.

Mr. Woodman combated the published claim that priorities have put or will put vast numbers of people out of work, declaring that but for priorities there would be four million out of work now.

He explained the different priorities rating plans and stated that copper can be used only for army, navy and lend-lease orders after Jan. 1. All inventories of copper in manufacturers' and smelters' hands will be frozen on that date. "If the situation looks tough now," he said, "it will be tougher later on." He also predicted a tremendous demand for all manner of civilian products after the emergency is past.

Plan Post-War School Buildings

NEW YORK — A total of $12,584,856 has been allotted to the Board of Education in the proposed capital budget for 1942 to complete buildings now under construction and to purchase new sites for future use.

250 Exhibits Planned for H&V Show; Additional Advisors Appointed

PHILADELPHIA — The need for improving working conditions and speeding industrial production in plants engaged in national defense operations lends special importance to the 7th International Heating & Ventilating Exposition, scheduled for January 26-30 next in Philadelphia. Members of the ASHVE, under whose auspices the exposition is held, are preparing for the biggest meeting the Society has ever held.

More than 250 exhibits are projected already for the Philadelphia Exposition, covering the field of heating, ventilating and air conditioning for industry, as well as human comfort in places of business and other institutions, and in homes.

Recognizing the broad base on which the exposition is founded and the many interests co-operating in its success, Charles F. Roth, manager, announces that the advisory committee, which was organized some time ago, has been enlarged to include representation of other leading organizations in the field.

Walter L. Fleisher, president, ASHVE, is chairman of the committee, to which the following new members have been added under the affiliations listed: C. F. Ames, Jr., Insulation Board Institute; Wharton Clay, National Mineral Wool Association; Theodore Irving Coe, American Institute of Architects; George C. Diehl, American Institute of Consulting Engineers; W. R. Hainsworth, ASRE; Wm. B. Henderson, Air Conditioning & Refrigerating Machinery Association; William A. Herr, NDHA; Frank Hoke, Stoker Manufacturers Association; R. A. Locke, Steel Heating Boiler Institute; Arthur F. Nass, Heating, Piping and Air Conditioning Contractors National Association; Albert J. Nesbitt, Industrial Unit Heater Association; H. S. Sharp, National Warm Air Heating and Air Conditioning Association; E. Szekely, National Association of Fan Manufacturers; R. S. Waters, Institute of Boiler and Radiator Manufacturers; E. C. Wente, Acoustical Society of America; J. W. West, Jr., American Gas Association, and Ray G. Whipple, Oil Burner Institute.

Smith Girls Conserve Fuel

NORTHAMPTON, MASS. — To conserve fuel for national defense, the college authorities have appointed girls to act as heating monitors. They are appointed weekly on every floor of the dormitories to close all windows at 6 a.m. and so save on heat. This action was taken because approximately one-third of the heat used in student houses is lost in the early mornings because of open windows.

Yarnall Receives Hoover Medal

NEW YORK—D. Robert Yarnall, vice-president and chief engineer of Yarnall - Waring Co., Philadelphia, steam specialty manufacturers, has been selected as the fifth recipient of the Hoover Medal. The medal will be presented to Mr. Yarnall during the annual meeting of the ASME here December 1-5, with the following citation:

D. Robert Yarnall

"D. Robert Yarnall, humanitarian, engineer, and a leader in the engineering profession, who rendered outstanding service as a member of a mission that fed the children of Germany at the end of the World War and that is now aiding refugees in this country and Europe and providing food and relief for the children and mothers of France. These distinguished public services have earned for him the Hoover Medal for 1941."

Mr. Yarnall served as a member of the Commission in Europe having charge of feeding German children in 1920, being stationed there for about nine months and during the latter part of his stay in Berlin served as Chairman of that Commission. In 1924 he was again sent to Germany under the auspices of the American Friends Service Committee and the General Allen Committee, being stationed there for about three or four months. In June, 1938, he and Mrs. Yarnall were sent by the American Friends Service Committee to Vienna to aid the refugees who were pouring into the Quaker office there. In December, 1938, in the company with Rufus M. Jones and George A. Walton he went to Berlin, under the auspices of the American Friends Service Committee, to interview German officials in regard to possible aid to be given to refugees in emigrating.

Again, in January, 1941, Mr. Yarnall, under the same auspices, went to England to investigate the relief situation there.

Bullard Completes A.C. Plant

BRIDGEPORT, CONN.—A new $4,000,000 air conditioned assembly building has been completed by the Bullard Company, one of the world's largest machine tool manufacturers. By its means last year's output will be doubled.

The building is 540 x 180 feet, is 60 feet high, and supplies three acres of production space. Glass used in the great walls is a heat-absorbing and glare-reflecting type.

UNSAFE TURNS *plus* EXTRA STRAIN WILL WRECK YOUR *Pipe Lines* TOO . . .

THE DANGER LIES AT THE **TURNS**

Hurtling power and a weak curve played havoc with this express train. Another failure at the turns. (*Acme photo*).

Weld your piping with TUBE-TURN fittings for stronger, safer, trouble-free, "turns"

Many railroad disasters happen AT A CURVE—because that's where strain and wear hit hardest.

Piping systems face the same hazards. Pressure, friction, stress, and erosion punish your lines worst *at the turns*—wherever there is a change in direction.

That's why it is sound engineering to insure the *utmost* safety and strength at these danger points with TUBE-TURN Welding Fittings.

Welding with Tube-Turns gives your plant the assurance and economy of piping systems with longer life, better performance, space-saving layouts and virtually no maintenance interruptions.

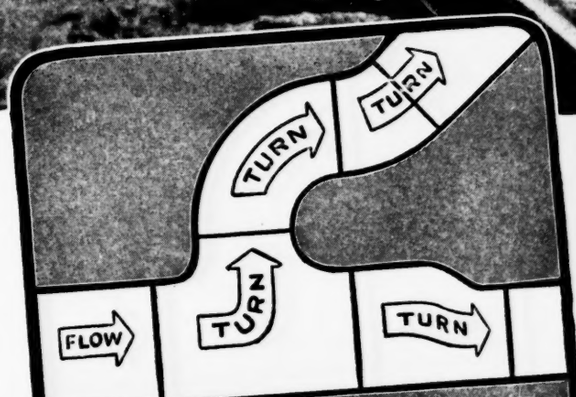
Write for helpful Tube-Turns engineering data book and catalog.

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. Distributors everywhere.

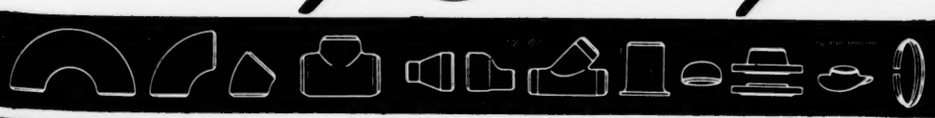
TUBE-TURN

TRADE MARK

Welding ★The★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*



As indicated in the drawing above, there are vital "turns" in piping other than at elbows and returns. Tees, reducers, laterals, and nipples likewise entail abrupt changes in flow direction that result in *added* strain, friction and wear at these connections. The built-in strength of *all* Tube-Turn welding fittings gives unequalled reinforcement for *each* of these *danger spots.*



News of the Month

Yaglou Reports Comfort Tests on Men Compared to Women

BOSTON — "When men and women wore similar clothing they were comfortable at about the same environmental temperatures," Dr. C. P. Yaglou told a committee of the American Medical Association that has just reported on extensive tests carried on at the Harvard School of Public Health by Dr. Yaglou and others. This was to learn why men and women prefer such different temperatures for comfort.

Dr. Yaglou, who conducted the tests, reports: "If women would dress in winter with clothes that are comparable with those of men they would be comfortable in a temperature of 72 instead of 76F and there would be less discord. Conversely if men would take off their coats, vests and collars in hot weather, buildings would not have to be cooled down below 83F, instead of 76 to 80F as at present, and difficulties now experienced with sharp temperature contrasts would be avoided."

In making the tests, the male subjects were dressed in women's clothing and the women in men's garments. Precise measurements were taken of temperatures at the surface of the body, temperature under the clothing over 18 parts of the body and the metabolic rates.

At 72F the average woman, dressed in her ordinary indoor winter clothing, reported she was uncomfortable. Her skin temperature was about two degrees lower than that of the average man, but the mean temperature under her clothing was 2F higher. Hands and feet of women were about five degrees cooler than men, the arms four degrees, the legs and head 2.5F cooler. There was only a half-degree difference between the two sexes in skin temperature on the trunk, constituting most of the body.

All the men reported that they were comfortable at 72. To make the women comfortable, wall temperatures had to be raised to 76. Then the men protested the heat. In warm summer weather, with air and wall temperatures averaging 80, the women were comfortable but most of the men were too warm. Yet when men and women wore similar clothes, they were comfortable at about the same environmental temperature, says Dr. Yaglou. These were but a few of the metabolic facts learned by the studies. In all but a few subjects comfort was associated with a mean skin temperature of between 91.5 and 93.5F in both sexes, regardless of air temperature. The mean skin temperature of women appears to average a half degree lower than that of men under comfort conditions.

U.S. Wants Heating Engineers

WASHINGTON — The Government is seeking heating, ventilating, air-conditioning, and plumbing engineers for national defense jobs. The salary range is from $2,600 to $5,600 a year. Readers qualified for and interested in getting one of these jobs should apply under the civil-service examination announcement for "Engineer."

There will be no written test for applicants who will be rated on experience and education outlined in their application. Address Civil Service Commission, Washington.

OPM Housing Curb Explained

(Continued from page 63)

sity for them. They have cast their personal interest entirely aside; they have done a very swell and patriotic job. We have reduced the four inch stack to three inches, and we are going to use standard cast iron pipe instead of extra heavy, except underground.

"We are doing the same thing with hardware. We are setting up a defense specification for hardware which is going to save between sixty and seventy per cent of the bronze and brass and, therefore, copper, which normally goes into hardware. The whole object of this priority system is to conserve these metals and in housing we are going to conserve them to the *n*th degree. As I said to Mr. Nelson not long ago, I am perfectly willing to chisel the use of metals in housing down to the bone; I am willing to spread copper so thin that you can't see it, but it burns me up to see it wasted in other classes of construction which are not under control and I think we are going to do something about that.

"On October 9 SPAB put out its famous statement which put the whole country on beam ends; partly as a result of misunderstanding and partly from shock. To those who hadn't been in Washington and had not realized the acuteness of the metal situation, the SPAB announcement came as a tremendous shock. Long distance calls from San Francisco to Boston asked if the announcement spelled the end of the housing program. Of course, it isn't the end of the defense housing program, and in those non-defense houses which have been started, we shall do everything to help them complete their buildings. But aside from completing buildings which are started, I want to say to you that the SPAB announcement meant exactly what it said. There will be no more non-defense construction that isn't essential. Just what do those words mean? I don't know and, I think, no one in Washington quite knows either. SPAB said in its announcement that it would lend its aid to the completion of those projects which are well under way. It would be hard to get a definition of that but there again we are fearful of laying down any hard and fast definition because what will apply in New York will not apply somewhere else. Conditions are different. I think every case has to be decided upon its merits; the interests involved and the impact upon labor.

"I think the shock came to most of those people because of their characteristically American optimism. We must face the fact that we are not going to pull through this situation without taking it on the chin and without taking it on the belt. If I do nothing else today, I want to leave that thought uppermost in your minds. We have reached a point now where if we are going on with the defense effort, we have got to make sacrifices. We can't go into a war—even if it were a simulated war—without casualties; and there are going to be casualties, and we have got to face that situation.

"I believe firmly that we are going to have no cataclysmic overturn; we are going to have no cataclysmic unemployment. Looking over the Bureau of Labor Statistics' figures, my guess is that we won't displace by stopping private construction or non-defense construction more than five hundred thousand mechanics and of course 1941 is the peak year of all years in construction. We are running over eleven billion dollars of construction this year; next year it is going to be perhaps somewhere between eight and nine, which is a big year.

"Now, the construction industry is pretty much up against it, and that includes the professions. I can speak with first-hand knowledge and a lot of sympathy for the architectural profession. They are out on the end of a limb. I think the time has come for the construction industry to conduct a campaign in Washington to sell the government a program which has been sold to the government mostly by labor or manufacturing. They put Mr. Odlum in charge of the Defense Contracts Service down there and his job is to spread manufacturing among the small units and, I think, we have got to do that in construction so that we begin to spread employment. We should not put all these huge jobs into very few baskets; they should be spread out, even by subcontract, and I think the same thing must be done with the professions — the engineers and the architects.

Big industrial job

or emergency housing . . .

Build for defense with

BETH-CU-LOY GALVANIZED STEEL SHEETS

There's a lot of building construction for defense going forward these days—and a lot of opportunities for you to be of real service. New factories for defense production, new homes for defense workers—both of these require large amounts of expert work on heating and ventilating systems. You can give these defense jobs real defense against corrosion by using Beth-Cu-Loy Galvanized Steel Sheets for all ductwork. Beth-Cu-Loy Sheets are protected, not only by a heavy zinc coating, but also by the addition of 0.20 to 0.30 per cent copper to the steel itself. Impartial tests by the American Society for Testing Materials have proved that a steel base of this copper content outlasts ordinary steel sheets more than two to one. Yet Beth-Cu-Loy costs only a few cents more per sheet.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

New Merchant Ships Have Cooling

SYRACUSE—All 14 of the merchant vessels launched simultaneously September 27 as part of the "Liberty Fleet Day" ceremonies at shipyards throughout the country, are equipped with some form of refrigeration or air conditioning, according to R. L. Tomlinson, manager of the marine department of Carrier Corporation. Eleven of the 14 ships are equipped with Carrier air conditioning or refrigeration systems.

Three of these ships, the *Patrick Henry*, *Star of Oregon* and *John C. Fremont*, are of the new Liberty Ship design, on which refrigerating systems are designed to maintain temperatures varying from 15 to 40F in the ship's cold storage boxes. One of the most extensive air conditioning and refrigeration systems will be installed on the *African Planet*. The *African Planet* will also boast an air conditioning system for the dining salon.

Another cargo-passenger ship being built for the Alcoa Steamship Company will have a ship's stores plant taking care of compartments for food storage, a separate plant for two cargo spaces, and an additional plant to air-condition the dining salon.

Parker Elected by ASME

NEW YORK—James W. Parker, vice-president and chief engineer of Detroit Edison Co., has been elected president of The American Society of Mechanical Engineers for the year 1942.

Vice-presidents elected at the same time to serve two-year terms on the Council of the ASME were Clarke F. Freeman, senior vice-president and engineer of the Manufacturers Mutual Fire Insurance Company and its associated companies, Providence, R. I.; C. B. Peck, managing editor of *Railway Mechanical Engineer*, New York; W. H. Winterrowd, vice-president of Baldwin Locomotive Works, Eddystone, Pa.; and W. R. Woolrich, dean of the College of Engineering, and director of the Bureau of Engineering Research of the University of Texas.

U.S.C. Course on Bomb Shelters

LOS ANGELES—Studies of air conditioning and sanitation to care for entire communities, including design and ventilation of bomb shelters and factories planned for speed in production, are among the radically revamped courses in architecture which the University of Southern California has introduced.

Smoke Nuisance in Boston Increases

BOSTON—This city is facing such a pall of smoke as it has not experienced in years, and will justify the criticism of Federal authorities as one of the two cities in the nation with the most soot. The smoke is said to be due to use of high volatile coal which has replaced low volatile fuel formerly used and of which there is now reported to be a shortage.

Former smoke abatement director David A. Chapman, who has been making a survey of the largest New England coal distributors, declares that smoking chimneys are responsible for 2,000,000 to 3,000,000 pounds of soot dropped on every square mile of Boston terrain annually and says that he is amazed at the quantities of high volatile coal being shipped here to replace the prospective shortage of low volatile coals.

Mr. Chapman added that "Boston is definitely in for more grief this winter from a smoke nuisance standpoint. While most of the largest heating plants in Greater Boston are designed to do a fairly good job with low volatile coals, the soft coals now going into storage bins cannot be burned here without polluting the atmosphere to an unbearable extent."

City of Janesville
Wisconsin
September 11, 1941
Barber-Colman Company
Rockford, Illinois
Gentlemen:
Sometime before the heating season sets under way we would like to have one of your field men check over the controls in our building.
We have no specific trouble to report; in fact, our repair expenses on your controls have been negligible for the past eleven years.
Please have your man come in to see me before he makes his inspection.
Very truly yours,
Henry Traxler
City Manager
WHAT WE MEAN BY
"MINIMUM MAINTENANCE"...
repair expenses on your controls have been negligible for the past eleven years.
The Janesville City Hall, Janesville, Wisconsin, is a fair sample of how Barber-Colman Electric Controls require little, if any, upkeep expense. This building has individual room control — a fairly elaborate installation — yet, as Mr. Traxler's letter states, the outlay for repairs has been "negligible" in the eleven years since the system was put in. Barber-Colman Electric Controls are designed and built to give a lifetime of accurate and reliable service with MINIMUM MAINTENANCE cost. This is an important factor that deserves thorough consideration when purchasing a control system.
SPECIFY!
BARBER B-C COLMAN
ELECTRIC CONTROLS BY BARBER-COLMAN
1224 ROCK ST. BARBER-COLMAN COMPANY ROCKFORD, ILL.

"Built when they built 'em right!"

OLD TIMERS often use that expression with real reverence. But to the younger generation it's simply the wise-crack of the fellow who has to put up with the old model. Of course the implication of the old timers that they once built better than they now do, is wrong. Everything from automobiles to air valves has been improved every year . . . and yet—

When an old timer points to an old Marsh Air Valve, Trap, Gauge, or Thermometer and tells you that it was "built when they built 'em right", don't overlook the fact that he wouldn't talk that way if Marsh products hadn't given a mighty good account of themselves for a long time.

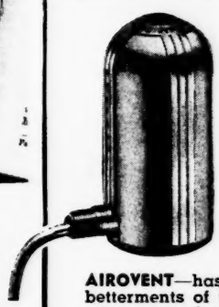
The open pages of an old Marsh catalog at the left, show the daddy of the variable venting automatic air valve. Of this valve and its descendents many a contractor has said "built when they built 'em right." And they were right all the way—because Marsh products have been right all the way.

Hundreds of improvements have been made in Marsh products since this old catalog was published. But our manufacturing creed has been to test so thoroughly and to build so conscientiously that twenty years from today you can look at the 1941 Marsh Valve, Gauge or Thermometer and say that it was "built when they built 'em right!"

JAS. P. MARSH CORP., 2089 Southport Avenue, Chicago, Illinois

MARSH

QUALITY HEATING SPECIALTIES SINCE 1865



AIRLINER—Best of the better valves. First valve to eliminate noise, spitting or spurting under *all* conditions. In four styles: adjustable or non-adjustable; with or without vacuum check.

AIROVENT—has the basic betterments of the Airliner at an attractive price. Adjustable venting with and without vacuum check.

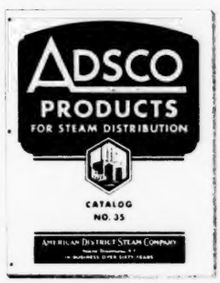
● *A real* packless valve. The exclusive Marsh metal-to-metal seal makes it permanently leak proof. All patterns and sizes.

● Marsh traps include radiator traps, float and thermostatic traps, and inverted bucket traps.

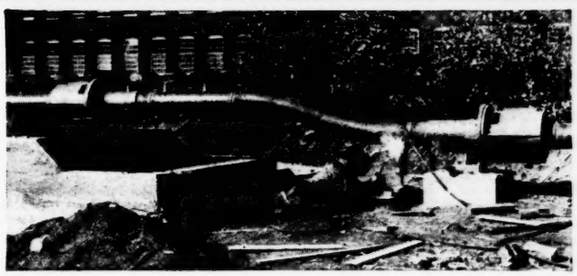
ADSCO STEAM and HOT WATER LINE EQUIPMENT

EXPANSION JOINTS, ALIGNMENT GUIDES, PIPE SUPPORTS, ANCHORS, MANHOLE FRAMES
for UNDERGROUND or SURFACE PIPE LINE INSTALLATIONS

The ADSCO Catalog No. 35



contains over 136 pages of descriptive data, dimensions, etc., covering all ADSCO Products.



Installing a Steam or Hot Water Pipe Line Soon?

If so, we have just the book you need to specify or purchase dependable underground conduit, expansion joints, pipe supports and other fittings for the installation—all fully illustrated and described in the latest ADSCO Catalog No. 35—used daily by consulting engineers, heating contractors and chief engineers in industrial plants, public utilities, colleges, institutions and government departments when time-proven steam distribution equipment is required.

Write today for your copy of ADSCO Catalog No. 35V

ADSCO PRODUCTS

●

Slip Type and Packless Type Expansion Joints.

Tile Conduit and Wood Casing for Underground Steam or Hot Water Lines.

Pipe Supports, Guides, Anchors and Saddle Plates.

Condensation and Steam Flow Meters.

Storage and Instantaneous Water Heaters.

Heat Economizers.

Steam Traps and Vapor Heating Specialties.

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

A.C. Committee Proposes Cut

(Continued from page 46)

The letter was signed by the subcommittee members, as follows: James A. Bentley (Carrier); W. C. Allen (Modern Equipment); F. H. Faust (General Electric); C. V. Hill, Jr. (C. V. Hill Co.); M. W. Knight (Peerless of America); L. C. Love (Ebco); P. A. McKittrick (Parks-Cramer); R. H. Pearse (Trane); and A. B. Schellenberg (Alco Valve).

Appendix I, covering statistical information on the AC&R industry, shows, among other figures, that 163,190 persons are employed, that the annual payroll is nearly $260 million per year, that the yearly installed cost of equipment (year ending August 31, 1941) was $566,960,410, that the industry occupies over 15 million square feet of floor space. Tonnage of material used for the year, the Appendix shows, was as follows: steel, 102,457; iron, 42,567; copper, 14,153; brass, 6,310; aluminum, 1,671; nickel, 1,193.

Appendix II lists the essential, less essential, and non-essential uses for both air conditioning and refrigeration. The air conditioning list covers the following (in this list MP indicates Manufacturing Processes):

ESSENTIAL: chemicals, M.P.; telephone and telegraph apparatus, M.P., and for telephone exchanges; drug and pharmaceutical, M.P.; electrical machinery, M.P.; explosives, M.P.; M.P. of flour, baked goods, cereals and miscellaneous foods, and for preservation, etc., of foods in stores and eating places; atmospheric control for operating and convalescing spaces in hospitals; factories, drafting rooms, and laboratories in industrial plants; laboratories; processing of abrasives; precision and tolerance of parts control; ferrous and non-ferrous metal working; mining and processing of metals; blast furnaces; optical apparatus processing; M.P. of precision instruments; plastics and other synthetic products; M.P. of synthetic and non-synthetic textiles including yarn spinning, fabric weaving, garment making, parachute making, hosiery making, and other fabric production; motors and engines; airplanes; trucks; ships and boats.

LESS ESSENTIAL: M.P. in radio tubes and apparatus; atmosphere control in broadcasting studios; processing in printing and publishing; processing of sugar and candy; stores, offices and hotels, auditoriums, public buildings as housing; leather and leather products; M.P. in paper and paper products, films, cameras, and auto plants.

NON ESSENTIAL: M.P. for cement, ceramics, glass, lumber; M.P. for electrical appliances; growing and sale of flowers; homes, apartments and banks; theaters; bars; clubs; M.P. in tobacco products.

Washington News

(Continued from page 56)

OPM in proposing the revisions were engineers from General Electric, Carrier, Frick, York, Airtemp, Vilter, and Carbondale.

Washington representatives of the air conditioning industry are accepting this evidence of OPM initiative as an indication that other desired changes may be possible under the emergency program — an assumption seconded by the proposed revision of plumbing codes, pending in the office of Leighton Peebles, new chief of the plumbing and heating branch of the Division of Civilian Supply.

Throughout the entire Washington scene, the dominating theme is that defense needs must come first. Wise is the manufacturer—or the individual—who takes immediate steps to adapt himself or his plant to this program. It is freely admitted in Washington that "after emergency" considerations are in the class of wishful thoughts at a time when increasing numbers in the Capital city thought is that the future itself depends upon how well American industry takes care of the immediate present.

It is expected that both the AC&R and the new Plumbing and Heating Advisory committees will urge their industries to take all possible steps to adapt at least a portion of their activities to defense production. With this in mind, the October 21 certification by OPM of the entire household washer and ironer industry is significant. OPM certified to the War Department that 34 companies in the industry faced severe unemployment due to curtailment of non-defense production and recommended that they be given special consideration in the placing of defense work.

Leighton H. Peebles, chief of the Plumbing and Heating branch, Division of Civilian Supply

Immediate result of the certification was the award of a $12,000,000 contract for the manufacture of .50 caliber anti-aircraft gun mounts to three companies in the industry. The three will share the work with others in the industry, under subcontracts.

The contract is the first worked out with an industry committee, and Army officials are said to be planning to watch the operations with considerable interest. OPM, on recommendation of its contract distribution division, certified the industry was capable of producing 17 different defense items, ranging from anti-aircraft machine gun mounts to bomb fin assemblies.

Gas Heat Up in Bay State

BOSTON—The relative importance of fuels used for home heating in Massachusetts, according to the annual survey made by division on the necessaries of life of the State Department of Labor, indicates an increased consumption of all fuels with the exception of anthracite and bituminous coal. Comparative figures for the 1939-1940 and 1940-1941 fuel years are given below.

Deliveries of domestic-sized anthracite showed a loss of 90,000 net tons and bituminous coal a loss of 20,000 net tons from the previous year.

Consumption of oil increased 23,600,000 gallons over the previous year.

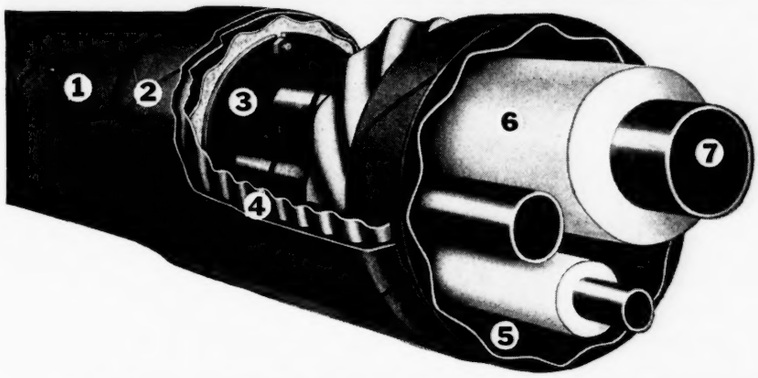
FUEL	1939-1940	1940-1941
Anthracite { Domestic Sizes	2,490,000 tons	2,400,000 tons
Anthracite { Buckwheat	190,000 "	194,000 "
Coke	890,000 "	900,000 "
Bituminous Coal	835,000 "	815,000 "
Briquets	39,000 "	39,400 "
Other Manufactured Fuels	20,000 "	24,500 "
Oil	906,000,000 gal.	929,600,000 gal.
Gas Installations, No.	8,590	10,058
Gas consumption, estimated	4,022,453,400 cu. ft.	4,154,256,764 cu. ft.

Giesecke Speaks in Los Angeles

LOS ANGELES — Dr. F. E. Giesecke, College Station, Tex., past-president of the ASHVE, was the guest speaker at the first fall meeting of the local chapter October 8. Dr. Giesecke's subject was "How to Use Research Results in Engineering Practice."

Current research, Dr. Giesecke declared, is largely being concentrated in four fields: (1) physiological effect on human beings from varying air conditions; (2) work dealing with distribution of air in space to be conditioned; (3) experimental work in radiant or panel heating; (4) research into the peculiarities of corrosion and its relation to friction and air stream.

RIC-WIL INSULATED PIPE UNITS



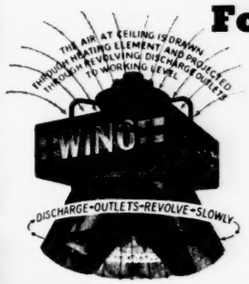
1—ASBESTOS FELT OVER ASPHALT COATED HEL-COR
2—THICK STRIP ASPHALT APPLIED AFTER WELDING
3—PIPE SUPPORT
4—COUPLER
5—AIR SPACE
6—SECTIONAL PIPE COVERING
7—STEAM PIPE

For the underground distribution of steam, hot water, or oil, use these modern, thoroughly engineered, factory built, pre-sealed units which are shipped complete as shown, in 20-ft. lengths or as required • High thermal efficiency, long life, low installation cost • Insulation any type preferred • Total prefabrication means important savings in time and labor on the job • Easy to specify . . . easy to buy • Ric-wiL is equipped for prompt delivery • Latest Bulletins on request.

THE RIC-WIL COMPANY • **CLEVELAND, OHIO**
AGENTS IN PRINCIPAL CITIES

---

27 WING Revolving Unit Heaters are installed in this Aircraft Parts Factory.


THE AIR AT CEILING IS DRAWN THROUGH HEATING ELEMENT AND PROJECTED THROUGH REVOLVING DISCHARGE OUTLETS TO WORKING LEVEL
WING
DISCHARGE-OUTLETS-REVOLVE-SLOWLY

For work that must go on—Wing Heaters Should Go IN

Concentrated hot blasts . . . energy-sapping hot spots, alternating with frigid zones that produce cold backs, cold feet and cold hands—these conditions have all been relegated to the past by WING *Revolving* Unit Heaters.

Now—in properly heated industrial plants an active, constant distribution of heated air uniformly throughout the working area is obtained by means of the slowly revolving discharge outlets of Type "R" WING Unit Heaters.

The gentle air motion created by the constantly changing direction of the outlets, successively covering an arc of 360°, is responsible for the feeling of refreshing, invigorating comfort experienced by workers and which makes them productive of more and better work with less energy.

Engineers and heating contractors should have *all* the facts on this patented construction. A new WING Bulletin will give you these; also installation diagrams, piping details and other data needed for installing this modern system of industrial plant heating.

Write today for Bulletin HR-1.

Some of the 63 WING Revolving Unit Heaters in plant of large Automotive Appliance Manufacturer.

L. J. WING MFG. CO.
158 W. 14th St., New York, N. Y.

WING *Revolving* **UNIT HEATERS**

UNIT HEATERS • VENTILATING FANS • EXHAUSTERS • BLOWERS • TURBINES

NEW EQUIPMENT

Stoker Timer.

Perfex Synchronous Stoker Timer

NAME—Perfex stoker timer.
PURPOSE — For operating stokers during off periods to prevent the fire from burning out.
FEATURES — This stoker timer is equipped with removable timing mechanism and employs a self-starting, line voltage, synchronous motor. The timer operates at 30 to 60-minute intervals with the hold-fire period adjustable from 1 to 11 minutes. To test the fire an external knob is turned until the stoker starts. A special feature of the control is a built-in fused line disconnect switch. The fuse can be changed without removing control cover. Models are also available without line disconnect switch.
MADE BY—*Perfex Corporation, 500 W. Oklahoma Ave., Milwaukee, Wis.*

Primoid Standard

NAME—Primoid Standard.
PURPOSE—A waterproofing compound for concrete, brick, stone and other types of masonry, as well as for wood and composition materials, such as shingles.
FEATURES—Product is a clear rubber-base liquid which can be either sprayed or brushed on. It is said to penetrate deep into the pores of the material to be waterproofed, effectively sealing the surface, and adhering permanently. It will not crack or peel off, and is not affected by heat or cold. Either dry colors or colors ground in oil can readily be mixed with it. It can also be used as a coating for iron, steel and other metals, and will prevent corrosion, because it is resistant to oils, alcohol, and other chemicals.
SIZES—Available in 1, 5 and 10 gallon cans, also 30 and 55 gallon drums; coverage 300 to 600 square feet per gallon depending on the porosity of the material being coated.
MADE BY—*Primoid Products Corp., 103 Park Avenue, New York, N. Y.*

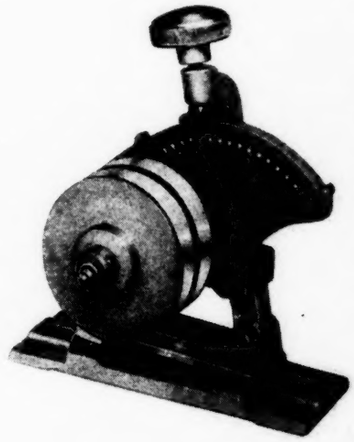
Pomona Pumps

NAME — Pomona vertical turbine pumps.
PURPOSE—An improvement in guide vane design for increasing pump efficiency.
FEATURES — Previously the guide vanes in the pump were constructed as thin as possible on the theory that the less metal the fluid would strike the less would be the resistance encountered. It was found by the Pomona engineers that because fluid being discharged by the impeller element flows across the guide vane at various angles, eddy-friction losses are encountered which reduce the efficiency of the pump. By forming these vanes in a bulbous shape it was discovered that the friction would be reduced and the efficiency increased. Inasmuch as the new guide vanes are an inherent part of the pump assembly it is not necessary for the owner of a vertical turbine pump to purchase a complete new pump in order to take advantage of the new design. It is only necessary to substitute a new bowl assembly.
MADE BY — *Pomona Pump Co., St. Louis, Mo., and Pomona, Calif.*

Mercoid Warm Air Control

NAME — Mercoid warm air control M-41 and M-43.
PURPOSE—M-41 control is for protecting furnaces from over heating while the M-43 control is to prevent the cold air from blowing into rooms when the furnace is not hot enough to deliver heat.
FEATURES — These controls have been re-designed so that they are smaller and more compact than former models. All the desirable features of the previous models have been retained with new ones added. Outside adjustments with full instructions on the face of the cover is now provided and a visible dial is provided which indicates the operating range for which the control is set.
LITERATURE AVAILABLE — Bulletin D-4.
MADE BY—*The Mercoid Corp., 4201 Belmont Ave., Chicago, Ill.*

Mercoid furnace control.



V-belt Variable speed transmission.

Standard Variable-Speed Transmission

NAME — JFS-CUB V-belt variable speed transmission.
PURPOSE—A transmission for varying the speed on V-belt drives.
FEATURES—This device is designed to be installed between the motor and the driven pulley. Speed changes may be made while the machine is in motion by merely shifting the control lever and locking it in place with a turn of the knob. Variations are made by shifting the pulley spindle towards or away from the motor driven machine thereby automatically changing the driving ratio of the variable pulleys. Manufacturer states that it is possible to mount this device in any position without impairing its functions or throwing the belts out of line. Control is especially designed for "A" section V-belt applications and for speed ranges up to 3.3-1.
MADE BY — *Standard Transmission Equipment Co., 416 W. 8th St., Los Angeles, Calif.*

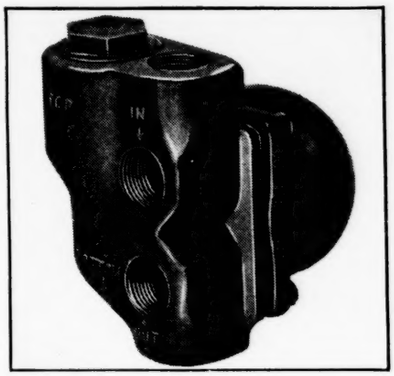
Marsh Tritrol Heating Control

NAME—Model No. 7 Tritrol regulator.
PURPOSE — For control of heating systems in buildings such as hotels, factories, and apartments.
FEATURES — Manufacturer states that the low cost of this control justifies its profitable use in buildings as small as two-family houses. The control regulates the heat from the outside weather conditions and incorporates such features as a hold-fire switch, an automatic cut-off when the outside temperature rises above 65F, and a special four position switch which provides added flexibility for those buildings which require varied heating programs.
MADE BY—*Marsh Tritrol Company, 600 S. Michigan Ave., Chicago, Ill.*

Improves Unit Heater, Unit Ventilator Efficiency . . .

New STERLING

Float and Thermostatic Trap

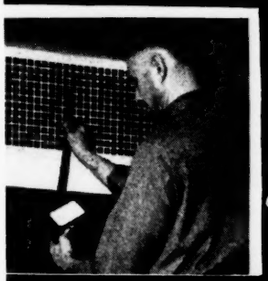


The new STERLING No. 69 is the smallest Float and Thermostatic Trap on the market! Offers versatility in pipe connection, ease in cleaning, and long service. Large capacity, despite remarkably compact design. Capacity—400 lbs. water per hour at 2 lbs. steam pressure, to 1200 lbs. at 20 lbs. pressure. Suitable for conditions from 25 inches vacuum to 20 lbs pressure. Sturdy, low cost. Weighs ONLY 7 LBS. Write for latest bulletin.

STERLING, INC.

3732-K N. Holton St. ★ MILWAUKEE, WIS.

The All Purpose



AIR VELOCITY METER

Alnor VELOMETER

INSTANTANEOUS DIRECT READING

ASK FOR BULLETIN 2448D

Illinois Testing Laboratories Inc.

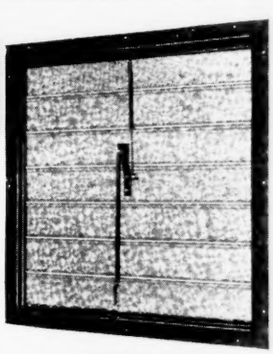
143 W. HUBBARD ST., CHICAGO, ILL.

Elgo Ventilating Specialties

Newest Thing in Automatic Shutters

Constructed with steel louvers instead of aluminum, and operated by a patented spring mechanism that makes the louvers open easier and wider, and makes them snap tight shut when the air current stops. Tension adjustable for different air velocities. No flapping or flutter.

Write for circular and prices!



"ACME" TYPE AUTOMATIC SHUTTER
Rear View (Closed)

Free CATALOG

ELGO SHUTTER & MANUFACTURING CO.
6968 W. Jefferson Detroit, Mich.

"All Out" HEAT

DRAVO

Direct Fired Heaters

Nothing short of "All Out" qualifications get consideration today . . . all-out speed: all-out performance: all-out economy. And the heating system that answers these demands is the Dravo Direct Fired method of heating large industrial buildings.

Speed of installation . . . just spot the heaters, connect and turn on for heat. *No* boiler plant required. *Top performance* as high as 86.5% heat transfer efficiency. *Economical* first cost and maintenance . . . used only when and where needed: easily relocated for permanent or temporary projects.

Dravo Heater sizes range from 750,000 to 1,500,000 B.t.u. p.h. Fuels are oil, gas, or coke oven gas. Refer to your Sweet's, then write or wire for 12 page data bulletin No. 502 showing quick solution for industrial heating problems.

SEE OUR CATALOG IN SWEET'S

DRAVO CORPORATION

Machinery Division — Heater Department

DRAVO BUILDING · PITTSBURGH, PA.

4800 Prospect Avenue, Cleveland — Broad Street Station Building, Philadelphia

Number of Degree-Days for September, 1941

HEATING AND VENTILATING begins its fourteenth year of publishing degree-day data for various large cities. Forty-six cities have been added to those previously published, making a total of 114 cities listed below.

City	Degree-Days Sept. 1940	Degree-Days Sept. 1941
Albany, N. Y.	173	128
Alpena, Mich.	192	182
Atlanta, Ga.	41	0
Atlantic City, N. J.	62	23
Baker, Ore.	200	388
Baltimore, Md.	49	8
Binghamton, N. Y.	177	113
Birmingham, Ala.	26	0
Bismarck, N. D.	127	280
Boise, Idaho	155	223
Boston, Mass.	111	89
Buffalo, N. Y.	137	73
Burlington, Vt.	215	202
Cairo, Ill.	46	7
Canton, N. Y.	202	196
Charles City, Iowa	134	117
Charlotte, N. C.	41	0
Chattanooga, Tenn.	70	0
Cheyenne, Wyo.	172	312
Chicago, Ill.	106	51
Cincinnati, Ohio	95	24
Cleveland, Ohio	119	53
Columbia, Mo.	70	47
Columbus, Ohio	106	26
Concord, N. H.	189	201
Concordia, Kan.	54	59
Davenport, Iowa	81	60
Dayton, Ohio	115	34
Denver, Colo.	71	166
Des Moines, Iowa	81	78
Detroit, Mich.	131	61
Dodge City, Kan.	55	60
Dubuque, Iowa	114	74
Duluth, Minn.	188	261
Eastport, Me.	296	252
Elkins, W. Va.	184	88
El Paso, Tex.	0	0
Erie, Pa.	125	59
Escanaba, Mich.	220	193
Evansville, Ind.	81	19
Fort Smith, Ark.	32	3
Fort Wayne, Ind.	123	58
Fort Worth, Tex.	7	0
Grand Rapids, Mich.	135	70
Green Bay, Wis.	158	116
Greensboro, N. C.	59	4
Harrisburg, Pa.	103	30
Hartford, Conn.	149	104
Helena, Mont.	159	436
Huron, S. D.	95	157
Indianapolis, Ind.	87	27
Ithaca, N. Y.	188	114
Kansas City, Mo.	58	43
Keokuk, Iowa	73	52
Knoxville, Tenn.	50	0
La Crosse, Wis.	123	111
Lander, Wyo.	125	371

City	Degree-Days Sept. 1940	Degree-Days Sept. 1941
Lansing Mich.	181	104
Lincoln, Neb.	65	71
Little Rock, Ark.	33	3
Los Angeles, Calif.	0	4
Louisville, Ky.	69	7
Lynchburg, Va.	67	10
Madison, Wis.	144	91
Marquette, Mich.	204	196
Memphis, Tenn.	31	2
Milwaukee, Wis.	134	105
Minneapolis, Minn.	116	137
Nantucket, Mass.	101	89
Nashville, Tenn.	51	1
New Haven, Conn.	106	72
New Orleans, La.	1	0
New York, N. Y.	64	26
Norfolk, Va.	26	0
Northfield, Vt.	291	272
North Platte, Neb.	60	132
Oklahoma City, Okla.	21	14
Omaha, Neb.	72	77
Oswego, N. Y.	177	121
Parkersburg, W. Va.	109	30
Peoria, Ill.	95	61
Philadelphia, Pa.	53	12
Pittsburgh, Pa.	99	32
Pocatello, Idaho	181	307
Portland, Me.	175	216
Portland, Ore.	48	113
Providence, R. I.	106	76
Pueblo, Colo.	50	134
Raleigh, N. C.	50	1
Reading, Pa.	95	35
Reno, Nev.	160	216
Richmond, Va.	62	7
Rochester, N. Y.	136	113
Roseburg, Ore.	61	143
St. Joseph, Mo.	65	62
St. Louis, Mo.	42	33
Salt Lake City, Utah	58	167
Sandusky, Ohio	110	36
San Francisco, Calif.	36	79
Sault Ste. Marie, Mich.	228	264
Scranton, Pa.	159	90
Seattle, Wash.	60	185
Spokane, Wash.	81	284
Springfield, Ill.	67	46
Springfield, Mo.	89	47
Syracuse, N. Y.	177	139
Tacoma, Wash.	93	212
Terre Haute, Ind.	77	31
Toledo, Ohio	124	48
Trenton, N. J.	86	34
Utica, N. Y.	193	148
Washington, D. C.	61	9
Wichita, Kan.	42	46
Yakima, Wash.	38	176

AIR CONDITIONING NOZZLES

Nozzles of unique Yarway Involute Design.

No internal parts or vanes to clog or erode.

Insure trouble-free air washing service.

Sizes and types for all requirements.

Many large users—installations total more than 5 million gallons per minute in water cooling and air conditioning service. Write for Bulletin N-615.

YARNALL-WARING COMPANY
104 MERMAID AVENUE
PHILADELPHIA

YARWAY

Complete Line....

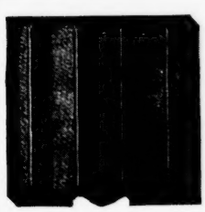
White-Rodgers complete line of Hydraulic-Action heating controls is built to fill your every need for automatic temperature control.

Accuracy, ease of adjustment, broad ranges, and simplicity of installation are responsible for the popularity of these controls among heating men everywhere. Learn what Hydraulic-Action can do for you by writing today for the White-Rodgers Condensed Heating Catalog!

Type 513 Single Speed Fan Control. Range 100° to 300° Fahrenheit.

WHITE-RODGERS ELECTRIC CO.

1207 CASS AVE. • ST. LOUIS, MO.



Make the first cost the last cost!

Where Somers Hair Spun Glass Filters are installed as original or replacement equipment there's an end to the cost. Somers Filters are washable, odorless, non-absorptive, do not rot, and are practically indestructible.

Dust, dirt, pollen and detritus in the air stream effectively removed with minimum back pressure. No adhesives required.

Somers Filters may be cleaned easily by using the stream from an ordinary water hose (at city pressures) pinched to obtain a spray effect.

SOMERS HAIR GLASS FILTER

For complete details and prices, write giving the c.f.m. per unit and dimensions of present master holding frame. A few choice territories are available for representatives. Full particulars on application.

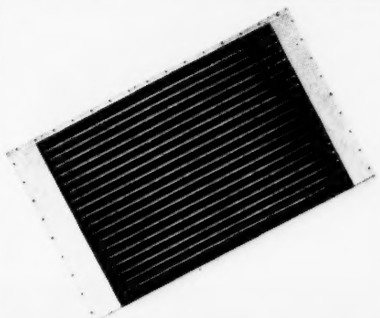
H. J. SOMERS, INC., 6065 WABASH AVE., DETROIT, MICH.

McCORD

HEATING AND AIR CONDITIONING PRODUCTS

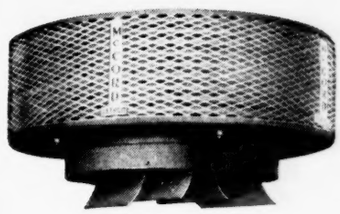
YOU CAN DEPEND ON McCORD Air Conditioning Products

BLAST HEATING COILS AIR CONDITIONING COILS ALL TYPES



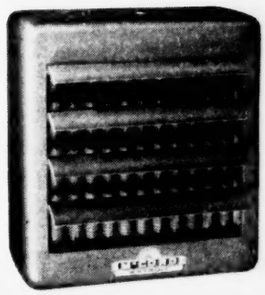
All copper tube fin construction, non-corrodible, high heat conductivity. Fins metallically bonded. Heavy copper headers. Ask for catalog.

VERTICAL TYPE UNIT HEATERS



Proven modern design, all copper spiral fin tube core. Supplied with louver, multi-cone or anemostat type outlet. Quotation on request.

HORIZONTAL TYPE UNIT HEATERS



Distinctive modern design, rugged dependable, all copper heating core, high heat transfer capacity. Core spring mounted. Specify McCord.

McCord RADIATOR & MFG. CO.
DETROIT, MICHIGAN

WITH THE MANUFACTURERS

Blocker Air Conditioning Corp., North Jersey and Staten Island distributor for *York Ice Machinery Corp.*, has moved to 33 Clay St., Newark, N. J., from 825 Frelinghuysen Ave., Newark.

Downingtown Iron Works, Downingtown, Pa., has set up a separate division for the manufacture and design of heaters, coolers and condensers. This heat transfer division is being housed in its own building and is under the direct supervision of men having long practical and technical experience in the design and fabrication of heat exchangers. Manager of the new division is *R. M. Armstrong*, in charge of design and sales of the new products. Assisting is *F. J. O'Sullivan*. Downingtown's consulting metallurgist, *Dr. T. H. Nelson*, will collaborate on problems involving unusual metallurgical practice. Products of the new division will include: storage water heaters, instantaneous heaters, freon water coolers and condensers, large drinking water coolers, large suction line heat exchangers for refrigeration.

Galv-Weld, Inc., Dayton, Ohio, has appointed *The Eagle-Picher Lead Company* as exclusive manufacturers of Galv-Weld materials for distribution to licensed users of the processes.

Philco Radio & Television Corporation, Division of Philco Corporation, Philadelphia, Pa., has sent to its distributors two new service plans—one on refrigerator service and one on air conditioning service, the latter covering the company's portable air conditioning unit.

PERSONALS & PERSONNEL

Blaw-Knox Co., Pittsburgh, has appointed *Edwin A. Wert* as vice-president in charge of engineering and sales of its power piping division. Mr. Wert, taking the position held until recently by S. J. Horrell, has been a consultant for the company for a number of years and comes from the Detroit Edison Company, where he has been engaged in an engineering and design capacity for 18 years. He is well known for his work on piping design and recently developed, in behalf of Blaw-Knox, simplified formulae for determining the stresses in power piping systems. Mr. Wert also is the inventor of Blaw-Knox functional spring hangers and vibration eliminators for high pressure-high temperature piping systems.

Edwin A. Wert

Charles Demuth & Sons, Garden City Park, New York, has appointed *William J. Caldwell*, 4524 Chestnut St., Bethesda, Md., to handle the company's line in Baltimore, Washington and portions of Virginia, West Virginia and Maryland.

Sterling, Inc., Milwaukee, Wis., manufacturers of heating specialties, has appointed *F. R. Grothey* as sales manager. Mr. Grothey has been affiliated with the company for the past fifteen years.

Cochrane Corp., Philadelphia, has appointed *W. B. Simons*, Charlotte, N. C., representative for its flow meters in the Carolinas.

The Mercoid Corp., Chicago, celebrated its 20th anniversary Sept. 22 when a group of old-timer employees, department heads, associates and close friends attended a surprise stag party at the Westward-Ho Country Club for *I. E. McCabe* on his birthday, coincident with the 20th anniversary of the date Mr. McCabe signed a contract with the company known as the Federal Gauge Company involving his mercury switch equipped automatic controls. Subsequently in 1928, a subsidiary was organized under the name of

J. W. Owens presents Mr. McCabe with a beautiful illuminated testimonial bearing the signatures of those present at the party.

The Mercoid Corporation which took over the manufacturing and sales of this popular line of control instruments. Mr. McCabe, the active chief engineer and chairman of the board of directors of the company, last year was numbered among the outstanding men of science and invention, selected by Dr. Karl T. Compton's committee for a modern Pioneer award. It was in the same year that he passed the one-hundred mark of inventions for which patents were granted to him by the U. S. Patent Office.

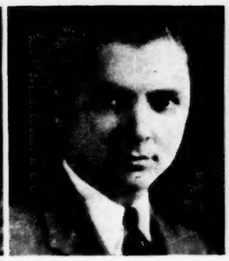
H. A. Thrush & Co., Peru, Ind., has appointed *Hester-Bradley Company* as its representative in the St. Louis territory, succeeding *Blaine H. Moke* who has been transferred to Washington as Thrush's representative there.

Penn Electric Switch Co., Goshen, Ind., has made the following personnel changes: *K. W. Cash* has been made sales promotion manager; *J. R. Netedu*, formerly assistant advertising manager of Fairbanks, Morse & Co., is appointed advertising manager; and *E. M. Ford*, for the past few years in the advertising department, has been promoted to assistant advertising manager.

Airtemp Div., Chrysler Corp., Dayton, Ohio, has appointed *William R. Groves* district manager. Mr. Groves, who will make his headquarters in Atlanta, was recently associated with the Westinghouse Electric & Mfg. Co., in the merchandising division.

Carl W. Millsom, Jr., has been appointed district manager for Western New York. Mr. Millsom, who will make his headquarters in Jamestown, N. Y., takes over the duties of *William Dennison*, who has been advanced to the position of Regional Manager of Texas. Mr. Millsom has been associated with the sale and distribution of Airtemp heating and air conditioning products since 1936, when he joined the Morgan Johnson Co. of Saginaw, Michigan, as a sales engineer. Later he became associated with the Coleman Stratton Co., Buffalo, N. Y., distributors for Airtemp. Early in 1940 Mr. Millsom organized his own company in Jamestown, New York, to wholesale Airtemp products in western New York.

J. L. Rosenmiller



F. C. Wood

A. Winther

York Ice Machinery Corp., York, Pa., has organized a new sales department known as the accessory equipment and maintenance department which will be headed by *J. L. Rosenmiller*. The new department includes all the personnel of the former service department and the former accessory equipment and supplies division.

Mr. Rosenmiller was graduated as an engineer of mines from Lehigh University in 1920. In 1923 he developed and became president of the York Oil and Chemical Company, which merged with York Ice Machinery Corporation in 1927, when he became manager of the accessory equipment and supplies division. For the past eleven years he has been manager of York's sales promotion division.

York also announces that *Fred C. Wood* has been appointed manager of its air conditioning department. He will devote his attention to the application of industrial air conditioning to defense plants in addition to regular civilian air conditioning requirements.

Mr. Wood, a graduate mechanical engineer from Cornell University, has been with York since 1928. In 1931 he was transferred from headquarters to the Westerlin and Campbell Company which functions as a York branch in six mid-western states.

York's advertising department has left its former quarters in New York City and is now combined with the sales promotion department of the company at factory headquarters in York, Pennsylvania. *Anker Winther*, assistant general sales manager of the corporation, will supervise the activities of the new advertising and sales promotion department. *Frank Chalmers*, who formerly handled advertising exclusively, has been transferred to York and will function in the new department as a specialist in advertising and sales promotion.

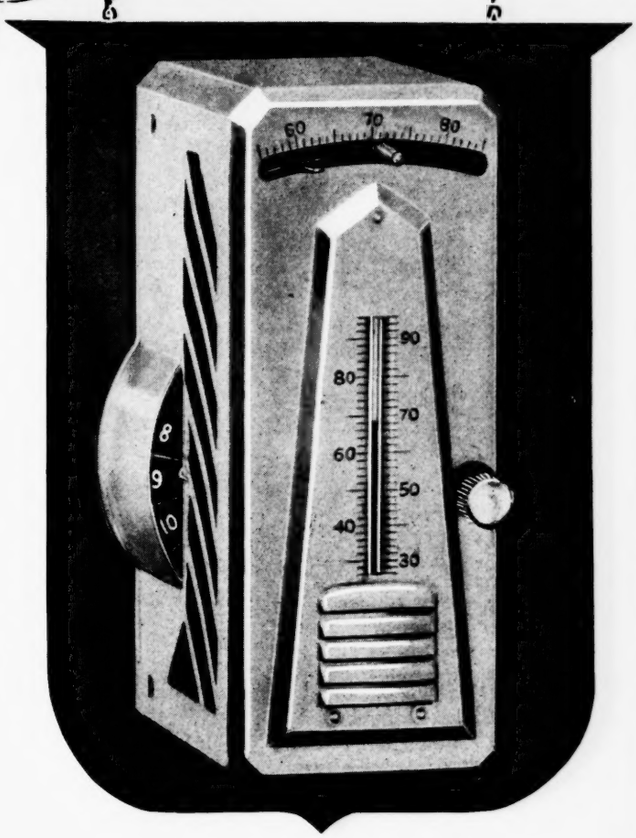
The Ric-wiL Company, Cleveland, has appointed *Fred Belser* as general manager of the company. Mr. Belser, a graduate of The Case School of Applied Science in 1916, has been associated with this company since 1928 in executive capacities. *C. Gottwald* continues as president and treasurer and *M. A. Hanna* as vice-president and secretary. The company has also appointed *A. V. DeFosset* as publicity director. He was formerly assistant advertising manager of the Seiberling Rubber Company.

Jack W. Green

Tube-Turns, Inc., Louisville, Ky., has appointed *Jack W. Green* as manager of its Chicago office covering that city and surrounding territory. Mr. Green has been associated with Tube-Turns in both the Louisville and Chicago offices. He was formerly with American Radiator and Standard Sanitary Corporation as manager of that company's Akron branch.

Mercoid

Offers a Simple Means for Saving Fuel Without Sacrificing Comfort



MERCOID SENSATHERM

DAY—NIGHT TEMPERATURE CONTROL

The National Defense Emergency makes it necessary to cut corners in every direction on waste. All fuels in particular must be conserved ★ The Mercoid Day-Night Sensatherm fits perfectly into this conservation program ★ This thermostat permits the lowering of the room temperature during the sleeping hours and automatically causes the heating plant to restore the temperature to the desired day setting, thereby saving fuel during the lower operating temperature ★ An excellent feature about this simple Day-Night temperature control over the clock type thermostat is that you control it—it does not control you. It is wound and set like a watch when you are ready to retire. According to American habits, there is considerable variance in bed time hours. With the Mercoid Day-Night Sensatherm there is no chance of subjecting yourself and company to a chill if you happen to be up later than usual.

An All Around Saving

1. The low price of this fine instrument will appeal to every home-owner—it costs less than one third the price of some combination clock type thermostats.
2. The clock mechanism only operates while you sleep and consumes no current. It will give many more years of service because of this feature.
3. There is less installation expense, as there are but two simple wire connections to the hook-up, the same as is required by the regular Mercoid Sensatherm. Thus, you can replace present thermostats with minimum of effort and expense.

You will be pleased with its small size, neat appearance and dependable performance.

Hermetically Sealed Magnetic Type Mercury Switch Used

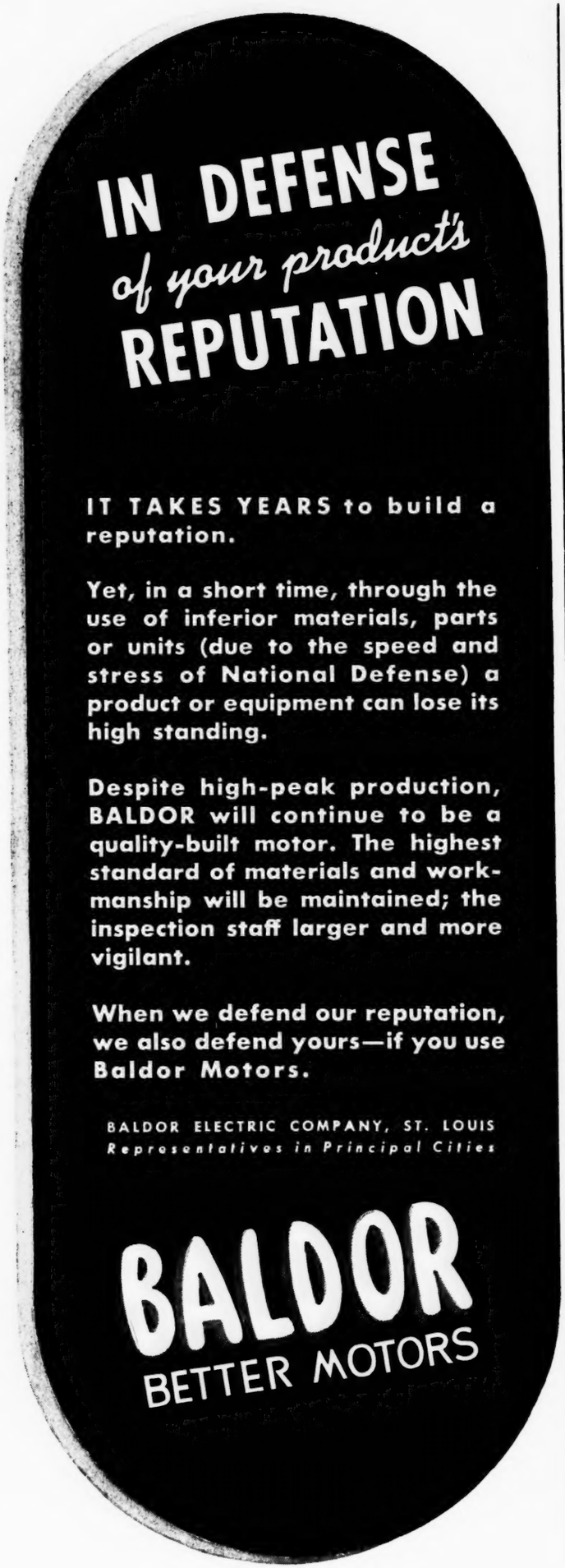
These switches are immune to dust, dirt or corrosion—a common cause for trouble. You have the advantage of this desirable feature at no additional cost. Write for descriptive circular No. D-2.

THE MERCOID CORPORATION

4205 BELMONT AVENUE • CHICAGO, ILLINOIS

MERCOID

THE EMBLEM OF CRAFTSMANSHIP IN FINE AUTOMATIC CONTROL INSTRUMENTS


IN DEFENSE
of your product's
REPUTATION
IT TAKES YEARS to build a reputation.
Yet, in a short time, through the use of inferior materials, parts or units (due to the speed and stress of National Defense) a product or equipment can lose its high standing.
Despite high-peak production, BALDOR will continue to be a quality-built motor. The highest standard of materials and workmanship will be maintained; the inspection staff larger and more vigilant.
When we defend our reputation, we also defend yours—if you use Baldor Motors.
BALDOR ELECTRIC COMPANY, ST. LOUIS
Representatives in Principal Cities
BALDOR
BETTER MOTORS

NEW TRADE LITERATURE

Controls. Two standard size, 6-page folders, one covering the company's Duo-Stats for control of hot water heating and the other for steam heating. Each describes method of operation of the Duo-Stat, the operation of Duo-Stat's outside temperature control, and each includes eight blueprint type drawings showing applications, hook-ups and connections for the control as well as photographs of the different type units available. JOHNSON SERVICE COMPANY, MILWAUKEE, WIS.

Unit Heaters. Standard size, 16-page bulletin HR-1, devoted to the company's revolving unit heaters and including photographs of installations, of smoke bomb tests, and of cutaway drawings, together with engineering data and descriptions of and specifications for this type of heater. Includes two pages on other types of the company's unit heaters. L. J. WING MFG. CO., 154 W. 14TH ST., NEW YORK.

Unit Heaters. Catalog U42, a standard size 6-page folder printed in color and devoted to the company's line of gas-fired suspended unit heaters. Explains construction, applications, types available, gives specifications and includes information on the use of the heaters connected to ducts. REZNOR MANUFACTURING CO., MERCER, PA.

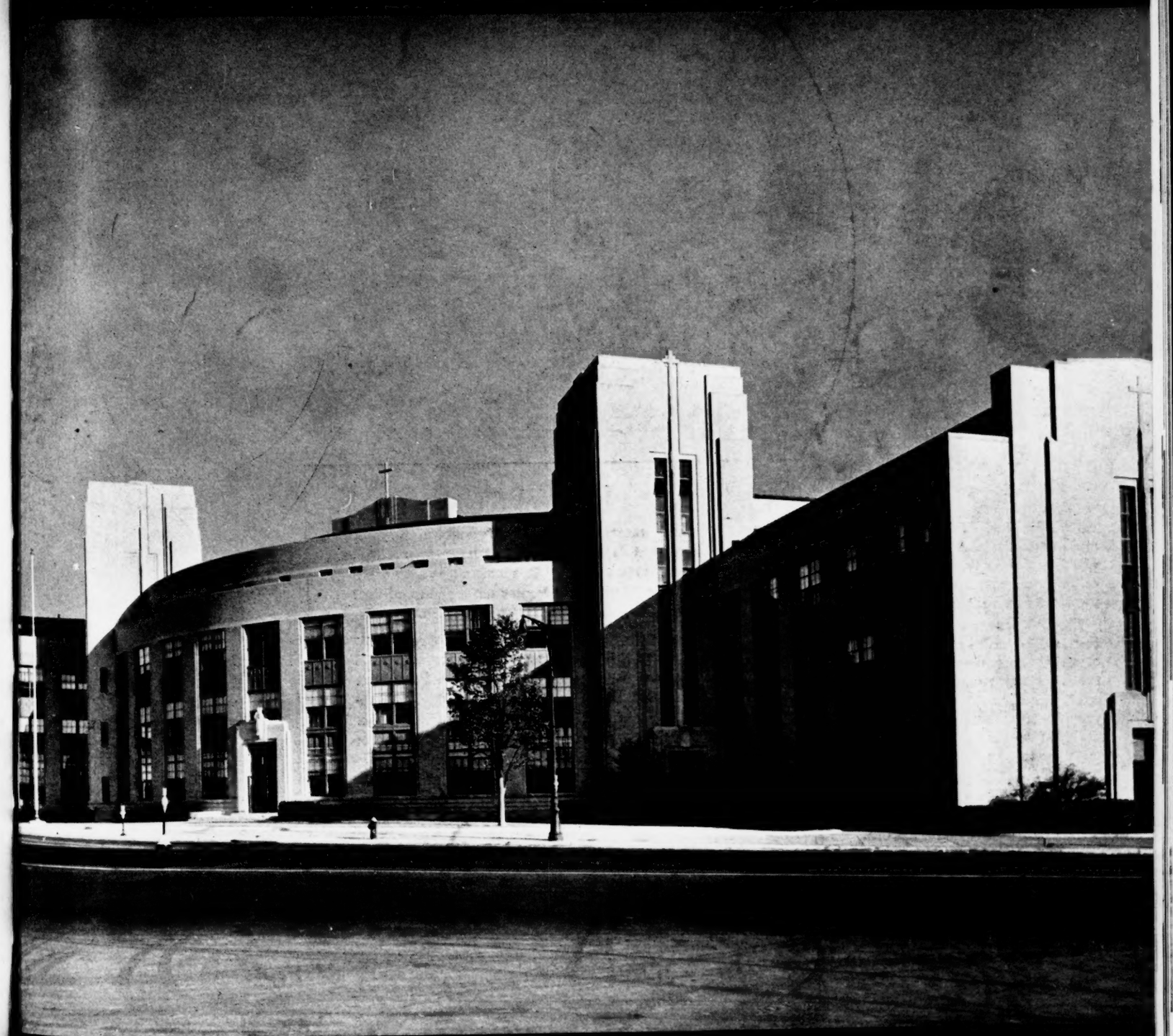
Air Heaters. Catalog No. AFA41A describing the company's automatic gas-fired forced air heaters of the floor type. Bulletin is a 6-page looseleaf punched standard sized catalog in color giving complete information, drawings, photographs, dimensions and other specifications. REZNOR MANUFACTURING COMPANY, MERCER, PA.

Freon. Two publications of particular interest at the present time due to the difficulties of obtaining this refrigerant. Folder A-2609 is a four-page display piece designed to give brief answers to some of the obvious questions arising from a shortage. The second publication, a pocket sized eight-page booklet entitled "Service Instructions — Freon Safe Refrigerants," is devoted to an outline of where losses occur with refrigerants and detailed instructions as to overcoming these losses and including transfer methods, leak detection, general precautions, and so on. KINETIC CHEMICALS, INC., WILMINGTON, DEL.

Humidity Control. Three folders devoted to the company's system of Kathabar humidifying and dehumidifying equipment. One is an attractively planned three-color folder prepared for production managers of industrial plants; another features comfort conditioning for commercial installations while a third deals with the general subject of humidity control for any type of installation. SURFACE COMBUSTION CORPORATION, TOLEDO, OHIO.

Regulators. A standard size 8-page catalog No. 2, devoted to the company's line of dampers, damper regulators, remote control regulators and accessories. Profusely illustrated. THE YOUNG REGULATOR COMPANY, 4500 EUCLID AVE., CLEVELAND, OHIO.

Coolers. Cleanable tubes with high efficiency heat transfer surface are now used in this company's shell and tube water coolers, described in this two-page data sheet CR-209 and devoted to the type 10T coolers. CARRIER CORPORATION, SYRACUSE, NEW YORK.

HEATING AND VENTILATING

The Air Conditioning Monthly